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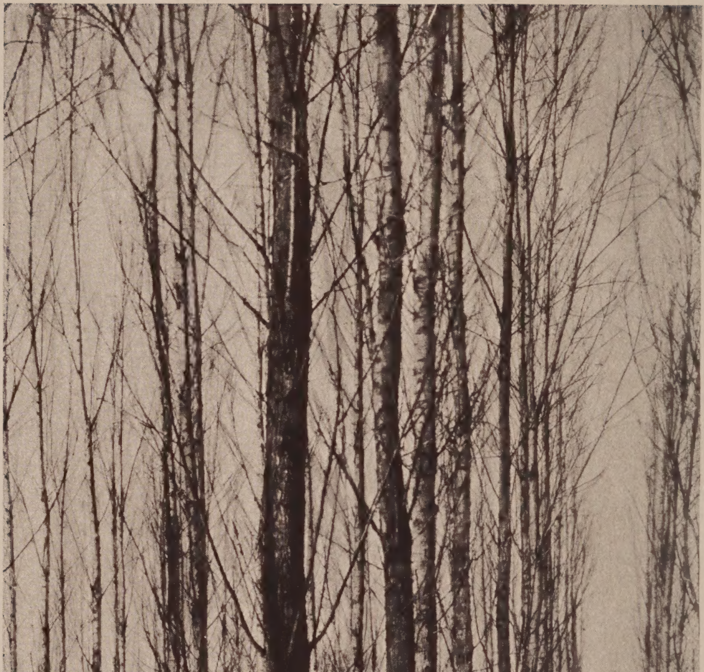

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Carolina Poplar plantation on experimental grounds near the Iowa State College, Ames, Iowa. Plantation was set out spring of 1909 with a spacing of 8 x 8 feet. The picture was taken January 14, 1922, about a year after a heavy thinning had been made. The trees vary in diameter from 8 to 14 inches at 4½ feet from the ground and average height of about 65 feet.

Forestry for Profit

How the Woodlot Can Be Made to Pay

By

Theophilus Tunis

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With 24 Illustrations

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PREFACE

THE object of this book is to give instruction as to how to convert a liability into an asset, by making the idle woodlot earn its share of the farm acreage, and how to make the left-overs pave the way for reproduction, by the modern method of artificial planting and all of the useful helps of the intensive system.

As a farmer, a tree grower, and a lumberman, from experience, observation, and study, at home and abroad, I undertake to explain both the modern method of handling and the reproduction of commercial forest trees, by the new system, that makes the woodlot pay, and pay its own way. I have embodied in these pages a mass of first-hand information never before presented to the public within the covers of one book, together with views of my own, "not all of which are in conformity with [so-called] established laws governing tree growth." The quotations are from the forestry officials of many States of the Union and colonies of English-speaking people, excerpts from the best authors and other authorities high in the profession. In the sum total of all of them, the real solution of the situation can be found.

A brief outline should be given of the various helps in successful commercial tree growing, of which the most important are complete surface drainage, the proper handling and sale of the woodgoods of the inferior and better kinds, clean cutting and brush burning, and the proper preparation of the soil and holes, spacing, selections of kinds and plants. Annual pruning is the foundation of the intensive system; it makes cultivation possible, which conserves the moisture, kills harmful vegetation, which in turn increases the growth of the trees, improves the quality of the wood, hastens the harvest, and fireproofs the planting.

The new system calls for a rotation of ten years, clean cutting one tenth of the woodlot each year, to be planted the following spring. We tell how and when to prune and plant, and also how and when to prune each subsequent season.

Our selection is of three kinds; the first of which is ready for the market the eleventh year after planting, at the beginning of the rotation, when all of the woodgoods that were on the ground at the beginning has been marketed. And all of the first variety will have been marketed within twenty-five years from planting time; fast enough to prevent overcrowding.

THE AUTHOR.

NEW YORK, January 20, 1923.

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CHAPTER I

The Story of Lotuswood and the Million Practical Foresters

THE story of Lotuswood describes in great detail the new system of artificial forest tree planting, growing, culture, and cropping, in such terms that the average farmer may follow in order to convert his idle woodlot into the most profitable part of his farm operations.

There is nothing new in any one of the important points, all of which are absolutely essential for the complete success of the system. But there never has been a working combination of them all as one whole, put in such usable shape for the farmer's instruction in that important line of his profession.

Heretofore there has never been a profitable market for his large and small left-over trees nor for his inferior ones, since his woodland was more or less cut over many years ago.

The changed situation in the supply and demand since then and especially since the Great War, must be met by better methods than those that have heretofore sufficed.

The new system has been combined in such usable details that may intelligently instruct the vast army of American and European farmers how to utilize their weedwoods, inferior and other timber and make them pay the way to reproduction, by selection, rotation and culture and care for a crop of woodgoods with a harvest to be ready to begin when the last of the forest products now in the woodlot has been marketed.

It is a story that should be intensely interesting not only to the millions of farmers but to the scientific, economic, and commercial world. It is well known by all classes of thinking people that the certain and early exhaustion of our timber supplies was greatly hastened by the extraordinary use and waste of woodgoods of all kinds by the late war.

The methods in use by the national and many of the state governments for artificial restoration of our depleted forests are movements in the right direction but now entirely inadequate for the urgent wants of the civilized world. The entire forestry force of both the States and the nation at no time ever exceeded 5000 persons of all grades, ranks, occupations, capacity and sex.

Europe is even more vitally interested in the subject than we are. We will here consider the question as of interest to only the ten or more millions of English speaking farmers.

When that army has a scientific system reduced to plain practical plans, that fit into their farm operations in such a manner as to afford steady, regular, all the year round work for both men and teams, utilizing horse power, either by animals, steam, gasoline, water or electricity, we can then clearly see how the 5000 trained foresters working only with hand tools will be outclassed.

Yet under conditions heretofore existing, the work they are doing was, and still is, in the right direction and should be continued along the same line as are our experiment stations for the benefit of better farming and forestry.

This new system of commercial forest tree management here applies to only three kinds of forest trees, selected to meet a special object, that is, an early harvest, a rotation that makes it continuous, and a method of treatment that not only increases the yield but improves the quality and safeguards the planting from fire.

Other selections may suit other localities, soils or conditions as well; in that case we are not sufficiently advised, nor is it important in describing the new system.

We assume it is only a question of time before those millions of farmers will realize the fact, that it is to them that the world must look for the needed supplies, and that it must be on the basis that the "Laborer is worthy of his hire." So long as Nature's ready-made supplies held out, that maxim did not enter into the subject.

Modifying our assumption so that instead of the ten million farmers mentioned, say only one million of them fully realized the importance of the situation, it is fair to assume that each one of them on an average would have one hired man.

This would give us two million ready made and equipped practical forest tree planters, able to combine such work with the routine of the ordinary farm work, teams and implements, with but one thing lacking, that is, instructions of how, when and what to plant and then what to do that will promise fair remuneration.

That is the purpose of the story of Lotuswood, and if it only hastens the day for the mobilization of that vast army to which 5000 trained foresters would be but a corporal's guard, the world may breathe easier as to the question of future supplies of woodgoods.

The story includes the usual method of conservation of the thrifty young growth of the better kinds of trees now there, but with no claim of anything original in that part of the system.

It is only to that part of the woodlot that clean cutting properly applies, that the intensive system is so essential to success, the only one that can offer the farmer any prospect of profit that would really be worth while.

An attempt to plant and raise a forest without a rotation for an intermediate crop of woodgoods would surely end in failure.

It is to that feature of forestry and in connection with our selection of forest trees of the commercial kinds—having in view a regular crop of both the woodgoods now and a rotation of intermediate crops and a real forest in the end—that our system applies, which is herein so fully explained.

This is in no sense a work on forestry, calling for no technical knowledge of that useful profession, but the subject, so closely allied, calls for frequent allusions and reference to it. Foresters are governed by rules of their own. This treats in a simple way a subject of unusual interest to them and to the farmer; to the latter the object is to instruct, to the former, to criticize and to be criticized, fairly in both cases, I hope, in order that the light may shine, where yet so much seems obscure.

I had gathered much interesting, statistical, historical and scientific matter, which I have cast aside in order to not encumber the pages with anything that does not tend to point the way to growing better trees of a kind that are already sorely wanted, and those fitted to produce results in the farmers' woodlots.

For the story of reproduction of forest trees as practiced by the profession, both state and national, does not in any manner fit into such routine as to make tree growing on lines practiced by the public of special interest to them.

It is therefore necessary to depart from the beaten paths, that to them have so far led nowhere, a fact well understood by the layman as well as those more directly interested.

It is by no means simply a treatise on how to grow forest trees, but how to grow better forest trees of the kind the world wants at a profit to the grower.

Which alone presents a new phase of the subject and calls for a new system to bring about a result that when properly understood should need no argument.

CHAPTER II

Natural Reforestation Not of Interest to the Progressive Farmer

THE growing alarm at the constant drain on the nearby supply of timber caused the National Government to take measures for the future. Under the operation of the Weeks law, a large appropriation was made in 1911, and has since been increased, to buy certain timbered lands, ostensibly for the protection of the water supply and the future utilization of the water power.

This act created the National Forest Reservation Commission for the purchase of such lands as the Geological Survey recommends, and already they have added to the public domain nearly two million acres, at a cost of little more than five dollars per acre, in the White Mountains of New Hampshire and the Southern Appalachians, in which regions there are some thirty million acres not generally adapted to farming which will most likely be included sooner or later in the Reservation. Some of these lands are cut over, some but partially so, and some not cut at all.

The present policy of the Commission is protection of the area already purchased and the extension of purchases in the same region. Some of these lands are bought subject to the late owners' right to remove the merchantable timber, under certain rules for the more careful protection of the smaller growth. This movement should in the course of time demonstrate the wisdom of the law.

It was well under way before the Great War when the price of everything in the way of woodgoods began to soar, thus opening up such a market for the farmer's left-over woodgoods as was not anticipated for many years to come. Nor need there be any fear of a slacking of the demand for timber now standing, good, bad, big or little, or that which may come from reproduction on the replanted clean-cut lands, all now of value beyond the cost of marketing according to location, because of the greater distance from the great markets, and the consequent higher transportation charges.

The high price of coal has already created a demand for firewood that has involved the production of special machinery for its economical handling, and with good roads and heavy trucks a good market, direct from the stump to the consumer, should hereafter be depended on. With the woodgoods, the market, the location, and the facilities, the time has come to bring the whole subject home to the farmer and the private owner of the woodland that he may investigate not the market alone but the best methods of handling what he has left on his idle woodlot and the plan of planting for a rotation of marketable woodgoods as fast as the present stand is fully cleared and replanted, instead of the usual one of planting for a forest of timber of saw log size—to clean-cut and market the woodgoods now on his land and with the net proceeds from the sale of the various kinds of weed-woods and inferior kinds of the left-overs meet the expense of clean-cutting, preparation of the soil and replanting and thus prepare to produce a future supply, which should make the value of his heretofore useless woodlot much greater than any like area on his farm. In due time, a new crop of woodgoods will be ready before the old crop of weed-woods is entirely exhausted. By a proper selection of a few kinds of commercial forest trees only, a continuous supply of marketable goods may be provided to yield larger returns than the average of the usual farm crops, and gradually increase the value of his farm.

The report of the Chief Forester to the Department of Agriculture as of October 4, 1920, states, page 222:—"Two thirds of the original forests of the United States have been culled, cut over or burnt, and three fifths of their merchantable timber is gone. The country is taking 26 billion cubic feet of wood annually from its forests and is growing but 6 billion cubic feet."

"There are still large quantities of timber in the United States but they are not in the right place."

"Sixty-one per cent of what is left lies west of the Great Plains."

"The exhaustion of one forested region after another in the Eastern States has been reflected in rising cost of transportation."

"At the bottom of the whole problem is the idle forest land."

"The United States contains 326 million acres of cut over and denuded forests."

"The area of idle or largely idle lands is being increased by 3 to 4 million acres annually."

From page 251 we quote:

"The steady depletion of our forest resources, coupled with the many changed conditions following the war, has led to increased demands for forest products. One of the more important is the pulp and paper industry."

"Fundamentally, the continuation of the newsprint industry as of other wood using industries, is dependent on the practice of forestry. The use of newsprint is increasing more rapidly than population, and the raw material in the region where its manufacture is centered is steadily decreasing."

"Approximately 95% of it is made in New England, New York and the Lake States." But a very few years ago Spruce and Yellow Poplar were considered the only woods suitable for pulp. Now all of the so-called soft woods are eagerly sought after. Some of the most inferior kinds are now the best for that purpose.

Our claim for artificial reproduction is only on clean-cut woodland or cut-over land, cut-clean. By our selection and system it produces a crop of one variety in 10 years, and in 25 years from planting time that variety will, in turn, give way to the pine which will have been clean-cut and marketed annually during the next twenty-five years, then leaving a forest of hard woods for the future, as will hereafter be described in detail.

These results will have been accomplished by the utilization of the inferior woods now on the grounds, the proceeds from the sale of which will pay the way of the new plantation.

They can be attained only by the most intensive methods of preparation, artificial planting and annual pruning, cultivation and a regular annual thinning, after ten years (for market), to give those remaining on the ground the space needed for continuous growth and an annual crop.

Thanks to the chemists, even our so-called weed-woods are now in demand for many purposes. All of the soft woods and some of the so-called hard woods are now used for pulp wood, and by preservative methods the inferior woods are now utilized for railroad ties and other purposes so that the left-overs are now of more value when near the markets than the original high grade forest trees were in times past. But the rate of growth of those inferior kinds is slow, and they so retard the growth of better kinds, that such woodlots can only be classed as partly idle or idle lands.

It is well known by the professional foresters, writers of text books, farmers and laymen in general, that reproduction of forest trees by natural methods offers the farmer no prospect of a profitable return for his time and money. Therefore, he must be shown some better way than has so far been recommended to him for the production of woodgoods for the future. Our purpose is to show him how to do it.

CHAPTER III

Marketing the Left-Over Inferior Woodgoods or Forest Products

WOODGOODS is a term used in Europe for forest products and timber supplies of all kinds. Their term of lumber so commonly used in this country applies only to the usual accumulation in the attic. We shall use the term of woodgoods in this treatise on forest production and trees, because we are planting for an early and continuous crop, and for a forest only as an incidental ultimate outcome of the intensive system. And the term will apply to such of the various forest products as will be harvested from time to time, before or after reproduction with equal appropriateness.

Notwithstanding my long experience with trees and woodgoods, and the certainty that my advanced theories are correct, though not entirely in conformity with the so-called laws governing tree growth, I have so fully fortified my position by long and laborious research to meet in advance the criticism that is sure to come against this new departure from orthodox rules—and the substitution of a system that the average farmer with a woodlot may safely be offered as a promising business enterprise, a system that blazes a new trail to successful artificial tree planting and growing for profit. We have no ambition to cover the great field of botany, of forestry nor of forest trees, or even of all commercial forest trees; but we claim to have made a new discovery of how to grow more and better trees in a shorter time.

It is intended as a guide in every step of modern methods of reproduction of a certain few of those kind of commercial forest trees, that have fewer enemies and drawbacks with greater market value and general demand and a promise of an earlier crop and larger profits than any other known to us.

The degree of success will be measured by the fidelity with which the rules of the intensive system are carried out.

CHAPTER IV

Lotuswood. Ideal Tree Studies. Farm Lands and Wood Lands. Drainage, Clean-cutting and Conservation

LOTUSWOOD is a typical grain, hay and stock plantation, fully equipped, a going concern of six hundred acres, one half of which is in farm land and one half in wood land, a short haul to the station on a through line of railroad, and by truck and trailer, on good roads, a short hour to a great city.

Of the timber and wood on the three hundred acres of wood land, about fifty per cent is hard wood of all kinds and sizes, mostly of oak, with some ash, walnut, locust, chestnut and hickory unsuited for pulp wood. The saw timber is of a variety that is in demand by the shipyards, railroads, furniture makers and builders nearby, and the smaller sizes, including the limbs from the saw timber, are used for firewood in the nearby city.

Of the other woods fifty per cent is of mixed so-called soft woods and such hard woods as are suited for pulp, including pines, gum, maple, sycamore, beech, birch and poplars, one half or more of which is of such timber sizes as are in demand for ties and other timber used by the railroads, after treatment with creosote. The remainder is of a size together with the limbs of the saw timber trees useful under the new order of things.

Besides the commercial forest trees mentioned, there are persimmon, dogwood, holly, and a choice variety of shade, lawn and orchard trees. This makes an ideal proposition for the scientific, technical and practical study of trees, also for their economical handling, reproduction, care and culture. In connection with the unusual advantage of co-operation with such an ideal farming operation, this system should give great encouragement to the movement of reforestation, a movement that must grow to such proportions as will astonish its most sanguine believers.

About one third of the stand requires the practice of conservation of the young growth by pruning and thinning (while the mature trees and inferior stock are being marketed) and two thirds should be clean cut and replanted. We proceed on the well known maxim that "what is worth doing at all, is worth doing well," and unless the farmer is prepared to live up to that idea, artificial tree planting should not be his vocation.

As already stated, the cardinal points of our system are good drainage, careful preparation of the soil, proper spacing and selection, regular cultivation and annual pruning of species and varieties for a rotation and gradual thinning of the marketable crop.

Drainage is the corner-stone of the system, without which maximum crops cannot be made, no matter how intensive the other points may be pursued.

Annual pruning makes cultivation possible. That fireproofs the planting, and increases the yield. The annual

Showing the effects of the combined operation of annual pruning and cultivation; increased quantity, improved quality and elimination of fire risk, in a clean-cut woodlot.

pruning eliminates the knots from the very start and thus improves the quality, without the cost of thinning except for the annual crop, and selection, secures the rotation and a continuous crop. Spacing utilizes the productivity of the soil, without overtaxing it.

The old method involves a thick stand for the purpose only of natural or self pruning, and the suppression of the weaklings. Until all of that is accomplished no clear growth can be made nor any diameter growth worth while of any kind. With the old plan there can be no commercial thinning for many years even after the trees have shed their lower limbs, hence no prospects of profits.

The cost of the extra plants alone will be more than the cost of extra preparation and planting by the intensive system. The system of the artificial sowing of seed is entirely too expensive, even if a stand could be counted on. There are some sections remote from the centers of trade and population when the process of reproduction by nature's plan will be the best for a long time to come.

In order to avoid confusion of terms and ideas to simplify and yet make more comprehensive what we will have to say, we will eliminate all technical, scientific or botanical terms, and use those supposed to be best understood by the general reader. All statements, estimates and probable results will be based on the legal short cord of one hundred and twenty-eight cubic feet for both pulp wood and fire wood, and in board feet (not cubic feet or log measure) for sawed lumber.

The estimated net sales are given at a material reduction from the high prices of 1921.

And for the sake of directness, clearness and brevity, anything like argument for the time being will be avoided. Facts will be stated as such and as are capable of proof, for which ample means will later be provided.

The operations at "Lotuswood" will be considered under two distinct problems, first, the proper and economical handling and marketing of the matured trees and the smaller sizes of all kinds which stand too sparsely to fully occupy the ground, and the weed-woods of all kinds and sizes already there, which we term clean cutting, an operation largely in combination with the ordinary farm work jointly using the same teams, implements and help. The second problem is the conservation of the thrifty young stand of trees of commercial value—details of both will be treated fully later on. It is assumed the same problems are involved to a degree with other farmers whose situation and condition are about like ours.

We do not recommend forest tree planting, pure and simple. That in itself can promise little or no profit, to the farmer without a woodlot, or a tenant farmer, who never expects to own a farm. We do, however, urge every farmer the owner or prospective owner of a woodlot carefully to consider the question both as a profitable and pleasurable part of his farm operation, a public service, and a privilege as well as a duty to his community and to posterity. We do not recommend planting forest trees on ordinary, cleared farm lands (that has ever been farmed) no matter how poor they may be, for with proper drainage, rotation, tillage and fertilization they may be restored much cheaper than new land can be made ready for the plow for crop tillage.

There may be many reasons why an exception may be substituted for the rule, such as wind breaks, improvement of the landscape or for æsthetic or sanitary reasons, hilly, rough, eroded or rocky soils. Ordinarily there are much better uses for farm land than for growing forest trees, a slow process at best, but none the less important in its proper place, and as a by-product on the farm, a veritable savings bank better than some life insurance policies.

Our first and most important work in the woods is drainage, to the neglect of which most farm failures may be traced. Our plans include two methods, the first being the conservation of the healthy young trees of both hard and soft woods, of all commercial kinds, where the ground is already sufficiently well set, either unmixed or mixed with matured trees; the second method is where the young stand is not thrifty or of the proper kinds, or the trees are matured and ready for market or the stand is too sparse. Then the clean-cutting plan will be the practice.

Of the three hundred acres of woodland already described, one third or about 100 acres is marked for conservation. This will not be in a continuous stand, for scarcely more than ten acres may be found anywhere in any one place that meets the requirements. A few acres here and there must be clean-cut and replanted, and eventually all will be so treated. About two hundred acres are now marked for clean cutting and preparation for prompt replanting, nor will this practice be continuous; every acre will be treated on its merits. Details of procedure will be fully described later on.

The selection of the species for replanting and the matter of supplies of the young trees or plants for replanting will also be considered later. Extensive preparation for nursery stock by many States to supply their own people with proper plants true to name is most timely, it will afford the most ample, economical and reliable source of supply of seedlings for transplanting to our own nursery rows. It is important to have the transplants ready at hand, when the proper season serves, for quick removal to their permanent places to avoid exposure, and secure an early start which is half of the battle.

Until our own transplants are of proper size or age, we shall also depend on the State nurseries for them also. Thereafter the seedlings of one or two years growth will be purchased from the State nurseries to be transplanted to the home nursery rows for future use. The site of the nursery rows also must be carefully selected and properly drained as so much depends on good plants.

We will not be tempted for any reason to save the first cost of nursery seedlings—to use seedlings from the forest, no matter how thrifty or handy they may be. The transfer from their shaded home to the nursery rows will end in failure. If of larger size, do not attempt to plant them in their new permanent homes in the open. No matter how prompt the removal and transplanting may be the percentage of loss will be great and the growth of those surviving will be slow.

In addition to both these valid objections there would be no economy. The purchase price of the nursery stock will be much less than the cost of digging and gathering those from the woodlands, no matter how near at hand and how thick they stand, or how sure they may be of the desired varieties.

CHAPTER V

Average Sized Farm. Market Value of Stumpage on the Idle Woodlot

ASSUMING the average farm, the owner of which may be interested directly in this question, will range from one hundred to five hundred acres each, one half of the acreage may be in farm land and one half in wood land. Much of this will be more or less cut over, especially as to what has heretofore been usually termed merchantable timber, where much of the inferior kinds and many small trees still remain as at "Lotuswood," while some will average more woodland and many more will average less than ours. In either case, any farmer having even less than one half of that number of acres will do well to study our practice carefully.

Our program is to clean-cut and replant the entire two hundred acres, and to conserve and improve the 100 acres all within ten years at the rate of about 10% of the whole, or thirty acres, more or less (including both plans) each year. The operation is to go on in combination or connection with the farm work only, without undue interference with either. Outside of the few skilled mill hands required temporarily part of the first year for a time now and then, simply a little larger farm force will be used.

On larger plantations a smaller percentage might be better for clean-cutting each year to the extent of replanting in fifteen to twenty years, especially if, as with us, the principal work is to be carried on with the farm force, with but a slightly increased payroll, that is, by shifting the force from one job to another, as circumstances and seasons demand, always giving the farm the preference. An extra team and driver, or more according to the size of the farm and percentage of woodland, should accomplish much for both, with little extra expense. On smaller farms a larger percentage might be completed each year.

Transplanted seedlings to the nursery rows will be the practice from the start, but as they should have one to two years to grow to give them the necessary stockiness, it will also be necessary to buy transplants during the first few years of our planting, even at a considerable extra first cost; time is too expensive to take needless risks. The work proceeds according to the plan to plant promptly as the cut-over land is made ready for planting.

We are now ready to begin to market our matured trees, and so much of the inferior kinds, not matured, as suits our plans (including the defective and deformed), either on the clean-cut land and the reservations, or both, as circumstances may dictate.

We hire a saw mill to saw the logs of proper size under a contract, at so much per thousand feet, we to do the logging, piling, inspection and shipping, selling and accounting. The lumber is to be sawed as per order and instructions furnished by us. The mill is to be moved by the contractor from place to place to shorten the haul of logs. It will be dispensed with during the first year, until the latter half of the ten years period.

A tree felling and log sawing outfit is at first provided, also a combined pulp and firewood sawing machine, all operated by gasoline. The latter will do the sawing of the hard woods for short stove wood, and of the small trees and branches of the large trees, either for firewood or pulp wood as the case may be.

The outfit should with five men clean-cut in proper length of logs and wood an acre more or less a day, according to the stand and size of the wood; two more in peeling season will be required to peel and pile the pulp wood and brush to keep up with the machine so that all the work may progress together.

At the same time we employ a chain or a wire rope, a tractor, or a truck or strong team of mules, horses or oxen, a driver, a boss and a helper to pull out of the ground all small weed-woods, brush and trash, together with all small trees (where the thrifty young stand is too sparse, or for which there is no profitable market). This may be done also at the rate of an acre a day, bunching and pulling out of the way of the other work going on on the same acre all at the same time, cutting and piling the small wood intended for the lime kiln (a very important adjunct of our program), also piling what remains, to be burnt when dry to make ready for soil preparation as hereafter will be fully described.

A little judgment on the part of the boss will soon discover how this process works as he proceeds. By hitching to the small tree about breast high, the tree is first pulled down and then cut, and so on to the next one, a powerful and effective means of getting rid of the trash cheaply and expeditiously. We enter into these details to encourage power, instead of man labor.

The tree feller saws the stump level with the ground (so as to offer but little obstruction in the preparation, drainage, and cultivation of the soil to the team or tractor). An acre a day is easily made ready for the disk by a bush or bog harrow, now manufactured for the purpose.

The team or tractor with the disk harrow should go over the ground promptly twice each way (as soon as the brush is burnt) to kill the grass, weeds, briars, bushes, vines, suckers or sprouts, which at the same time helps to make the soil more friable, and to absorb and conserve the moisture. Then again, just before time for transplanting early the following spring that operation is repeated. Plowing would be impracticable in ground of that kind, and even the disk would have to steer clear of some of the greater obstructions, but it is quite sufficient; only a few trees need be omitted on that account, which is a matter of small consequence.

As the planting is to be done in the early spring, the first 10% of the woodland will be ready for planting long before the season serves. Because of the importance of getting rid of the saw mill the extra force kept on hand for that purpose may in the meantime utilize what otherwise might go to waste. They can follow the logging crew and cut the firewood and pulp wood from the limbs of the matured trees, and the weed-woods of sufficient size; and cut and thin out trash, defects and weed-woods of smaller size and so improve the stand of the thrifty young trees in the reservation for conservation, and thus keep all fully occupied and hasten that part of the work.

There is no need thereafter of using more than a small force except during part of the season from April to August when the bark slips freely, from the pulp wood; but for the importance of securing the benefit of easy peeling, all of the work could be done in the winter time—except the pruning and shipping and the work for the conservation of the thrifty young growth. The first work after that time should be in the reservations of the young growth, so that the extra crew could properly thin and prune the trees and otherwise improve it, in order to give it a fair and longer chance to grow for the next ten or fifteen years during the time the other woodgoods and weed-woods are being marketed and the replanting of the clean-cutting ground is being completed. It is not contemplated that we should completely destroy at once all of the weed-wood in the conservation reservation, as will be done with the clean-cutting method. The operation being a joint farm and logging one should be worked at convenient times. After the first season, pulp wood can be cut and peeled better by contract ahead of the clearing.

The capacity of the log and wood sawing machinery is so much greater than is required to clean-cut the woodland within the allotted time, that is, at the rate of 10% annually, that the interchange of labor and teams will be for the mutual benefit by keeping the farm work always up to or ahead of the season, combining at harvest and such other times when farm work is pressing, without interfering with the saw mill contract. Logs can be hauled ahead of the mill's everyday needs, and shipments of lumber postponed to a convenient time. Such an operation, especially the logging part of it, should be under the supervision of the farm manager, who with but a slight extra force will anticipate and meet all of the requirements in a much cheaper way than by two independent operations.

The cost of the tree feller, the log and wood sawing machinery will be met many times over in an operation approaching this size by the economy in man power alone. Then too, the low stump increases the value and produces an extra yield of lumber, much more than sufficient to meet it again. Besides this, there is the benefit in the easier preparation of the ground, for the future cultivation of the new planting of the clean-cut woodland. The use of the tree feller is almost indispensable. Felling trees by man power is a back breaking job. The value of the material wasted in the high stump (the best part of the tree) is also a very important matter.

We utilize what we call weed-wood as fuel for the lime burning outfit, to convert limestone and oyster shells into lime for the benefit of the farm land and the new planting. It may be burnt also for sale as such or for building purposes, both at home and for shipment. A lime kiln of considerable capacity, located at the railroad station, will be an important part of the equipment for this operation at Lotuswood.

CHAPTER VI

Cost of Clean-Cutting, Handling and Hauling Standing Timber, Weed-Woods and Burning Brush on the Woodlot.

THE net value per acre for stumpage for the wood-goods now standing at "Lotuswood" considering its location would be fair at the following prices:

4000 ft. of lumber-stumpage net value at $12.00	$ 48.00
15 cords of pulp wood and firewood stumpage, net val. $4.00	60.00
	$108.00

And then yield a fair merchant's and manufacturer's profit which would be sufficient to meet all of the cost of handling the weed-wood for lime kiln use and clearing the ground of trash, burning what will be left as useless, and for drainage, preparation of the soil and holes and purchase of plants, fertilizing, inoculation. pruning and cultivation without counting any value from the lime kiln fuel.

In this estimate of value of stumpage, it will be noted that we have at Lotuswood a much larger proportion of matured or merchantable timber, mostly of the better grades of the kinds that were considered merchantable under the old order of things.

A larger outfit and force is utilized during the operations of the saw mill than if the proportion of lumber and wood were reversed. For that reason this extra force is justified during part of the first year only. Before the end of that time that part of the timber intended for the saw mill will have been removed. Only so much of the ground as is intended for replanting, that is, one tenth of the whole, will be completely prepared for that purpose each year.

The estimated value for the standing timber at "Lotuswood" may appear to be high. Not so when considering its kinds and nearness to the market. That is, the profit over and above the value of the stumpage and the cost of handling, operation and sales in the hands of a working expert, and under the new market conditions in combination with farm teams, help, etc., would be generous after all of the cost of clearing and preparation for planting and making the embryo forest complete. Of course, if sold to a saw mill man as it stands, much of that sum would be his profit.

The farmer or private owner of wood land should not be misled by this statement of results, but those who are as favorably located with a stand of timber comparable with ours, with good management and modern methods of the intensive system, may fairly expect just as good results. Discount this statement as drastically as you may, there are few farmers who can afford to ignore the advantages the times and present conditions offer, not only to realize so handsomely on what now becomes an asset, heretofore a real liability. At the same time they convert a sore spot or eyesore into a thing of beauty. Even if one might not live to enjoy the full fruition of his labor he should ever after be proud of the day he decided to beautify the idle woodlot, the combination of the useful and the beautiful that increases the pleasure of both.

The basis on which we estimate the cost of clean-cutting, piling and burning the brush on the woodlot, draining and disking, digging holes, liming, fertilizing and inoculating, cost of plants and planting is three dollars net in excess of allowance for preparing 15 cords of pulp and stove wood and felling, sawing and logging four thousand feet of logs at three dollars per cord and per M, equal to a credit of fifty-seven dollars for work done on one acre, that leaves a very substantial profit from the sale of woodgoods beyond the estimated net sales hereafter referred to.

In this estimate I have allowed ten dollars for the use of team and machinery and three dollars the day for labor, that leaves a net cost in excess of credit for the preparation and planting of only three dollars per acre. While the net cost at Lotuswood is reduced because the quantity of woodgoods handled there is much above the average of a partially cut-over woodlot, on the other hand so is the credit. But it would be a poor woodlot indeed that would not average two thousand feet of logs and eight cords of wood, the handling and preparation of which at the same rate ($3.00) per cord and thousand would make a credit of thirty dollars against the clearing preparation, plants and planting of an acre with 726 trees of our selection in the very best manner to secure profitable results, from the average of the idle woodlots, at a net cost of not exceeding ten dollars per acre. On the basis of present prices of stove wood, pulp wood and logs, the stumpage at no greater cost of haulage than at Lotuswood should net on that idle woodlot fifty-six dollars per acre, or forty-six dollars in excess of the cost of clearing and planting it.

On acres of woodland yielding less than the one just referred to, the farmer could dispense with the machinery and the hired day labor, using contract labor for cutting and peeling pulp wood, and saving the firewood for home use, doing the piling of the brush and burning it by his farm help or at odd times; one tenth of his woodlot so treated every year would prepare the way for a good income beginning on the eleventh year after the first clean-cutting begins.

We go a little further and suppose the farmer's woodlot has no saw logs, or no firewood to dispose of, only a crop of five cords of weed-woods, soft inferior trees suitable for pulp wood only; it should yield a net value of $20.00 per acre over the contract price of cutting and peeling. There need be no iron-clad rules as to the proportion of the woodlot that should be cleared and planted each year.

Assuming one tenth each year for the smaller farmers, the sale of the soft woods alone will meet all of the costs. At the end of the tenth year all of the old woodgoods will have been sold, and on the eleventh year all of the woodlot has been replanted, and the first crop of new wood begins to go to market from the first planting of ten years before with an additional one-tenth each year following for the next nine years when all of the acres are then working. After the eleventh year, more attention may be given to that portion of the woodlot on which the conservation plan is being used, parts of which may then if desirable be clean-cut and replanted in order to maintain the regular shipments, until the end of the rotation, fifty years from planting time.

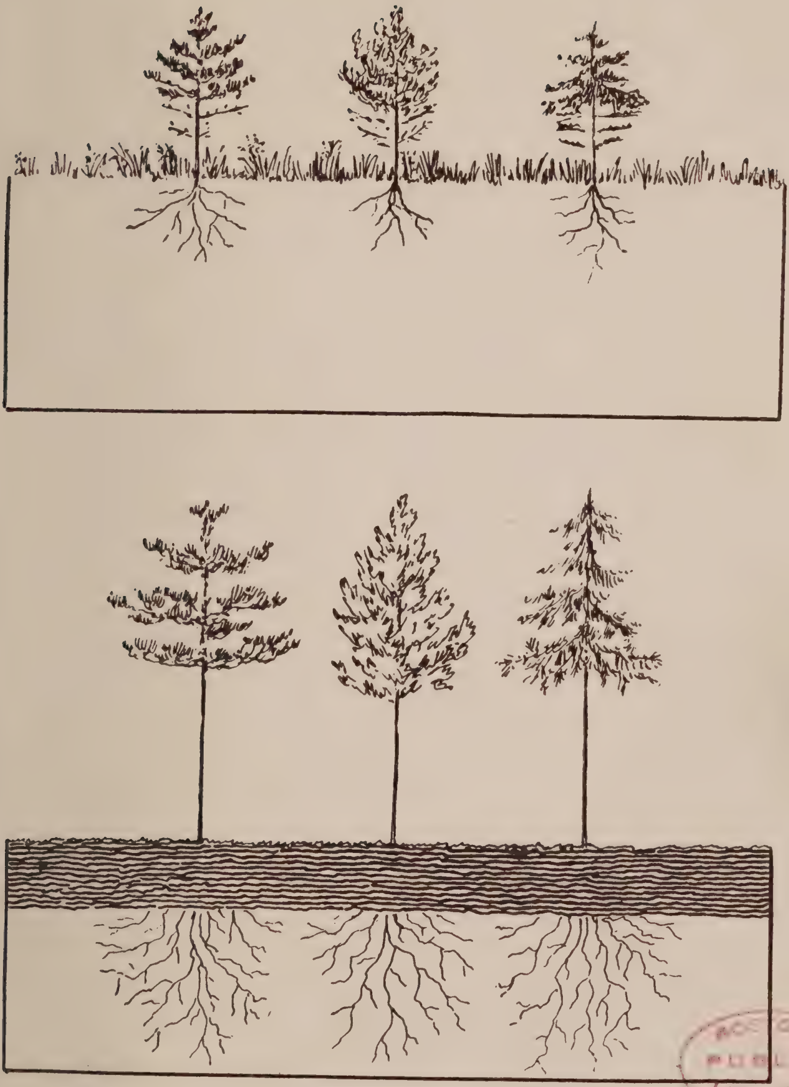
These three examples may be considered a fair average of the various yields of wood lands, cut-over or partially so. After the tenth year if the new system is fairly practiced neither of them should have any advantage because of previous conditions.

The cost of cultivation and pruning should not exceed three dollars the acre a year. The question of further cultivation and pruning will be considered later on.

Some compensation should also come from the knowledge of the fact that the farm is growing in value, little by little from year to year, like a savings bank account; long before the new harvest is ripe and ready and waiting for the market, that may be expected before all of the woodgoods now standing at Lotuswood has been handled and sold. One should experience the same feeling of satisfaction that one finds in making "two blades of grass grow where one grew before," provided there is a legitimate demand for the extra blade.

The good results growing out of the initial step, the proper drainage of the wood land, would be worth more than all the cost, in the improvement of the health and general conditions, the destruction of the breeding places of vermin, mosquitoes, snakes and other pests and varmints.

In reviewing our experience with the hope that it will be followed by many who are more or less similarly situated, we will again say it is not an operation for the tenant and the poor farmer. But the tenant or poor farmer



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Trees artificially planted, same time, kind and spacing, showing the difference of cultivation and annual pruning.

of to-day may be the big farmer of to-morrow and to them as well as the others now directly interested do we commend these pages.

To the small farmer having less than 20% of his farm in wood, we would not recommend the clean-cutting plan, except to restock sparse spots, to be planted at leisure, as there might not be sufficient net proceeds from the sale of woodgoods after the wants of the farm have been supplied, to pay the way for such an operation. We would not encourage the outlay unless it pays its own way from the sale of the woodgoods already standing on the woodlot, except to owners of means and not hampered with debts or the small farmer who does the work himself.

We would, however, at any rate, urge him first to drain his woodlot, as he would his garden, and to guard with more care the thrifty young trees of the commercial kinds and to market or destroy the weed trees as expeditiously as his time and help permits. The cheapest way this can be accomplished is with a team and an axe. The larger worthless ones may be attended to when time serves at the right season by girdling, saving the expense of prompt removing, as the dead tree is not a tax on the productivity of the soil at the expense of a more worthy live one. A little labor now and then without extra outside expense, will be highly rewarded. While these are all problems of the story of Lotuswood, the conservation method is no part of our new system—it is more properly handled by the technical forester, or on his recommendations.

All of these details, to the casual reader or those who may not be interested directly in the prospective operation, may appear very tedious, but as this is a new but most important field of endeavor, one on which so much depends, we hope to omit nothing which may throw light on the subject, even though a very large portion of our readers may understand some of these things as well or better than we do. But as others may not, we feel that our knowledge gained by experience, and our study of the subject covering such a long time justifies our opinion that any useful rule of action should be now stated even at the expense of apparent repetition.

Our system considered as a whole is so radically different from the teaching of the schools of forestry, as laid down in their approved text books, that is, so far as artificial methods of forest tree planting, culture and care goes that it is of the utmost importance that the details of our system should be fully explained.

The twenty acres of clean-cut land having been carefully drained, as well as the completion of the drainage of the woodland and of the entire farm, the most important step in this enterprise has been accomplished, the wood-goods handled, sold and delivered, and the useful weed-wood removed and carefully ranked for lime kiln fuel and the remains burnt. We are now ready to proceed with the preparation of the soil for replanting the first one tenth of the clean-cut grounds.

CHAPTER VII

Preparation of Soil for Planting. Intensive Methods. Draining, Spacing, Selection of Trees

WHILE our stumps are cut level with the ground it is not by any means a proposition for the plow, but with our disk harrow, the team or tractor by going over the ground two or three times will put it in sufficiently good condition for our purpose. It may be necessary to drive around some of the big stumps, but missing a few trees here and there will not materially affect the proposition. The cost of the preparation is comparatively trifling considering the advantage in killing the weeds, grass, briars, vines, bushes, sprouts and suckers, and thus gradually putting the ground in such tilth as to conserve the moisture so essential for the young plants especially the first year or two, and at the same time to protect the planting from fire.

Just before planting time in the early spring the holes already prepared the previous year should be carefully dug over again a foot deep or more and wider, in which a mixture of potash, phosphorus, lime and inoculated top soil should be well mixed. The planting should go on just as we would plant an orchard of fruit trees, on the fresh-turned soil using the ordinary long-handled farm-shovel to make the opening, pressing it forward for the plant, and then pressing the soil firmly with the feet around the plant, and trimming the young tree of terminal buds of the lower side branches only, the first year.

Our selection of commercial trees for our mixed planting will be White Pine, Loblolly pine, and Carolina poplar or Cottonwood. Their merits are well-known in their natural home and their usefulness can be greatly extended. Description will follow in detail later.

A spacing of 6′ x 10′ requires 726 trees to the acre, 363 of which are to be the two kinds of pines and 363 cottonwoods, the latter as a filler in for an early crop, with alternate rows in quincunx form. The cottonwoods are 10′ x 12′ apart, and so are the pines.

The cottonwood is a rapid growing tree under even adverse conditions, but forced by intensive methods should attain a maximum height growth of fifty feet and a diameter growth of twelve inches at the stump in ten years from planting time, a size that should yield large annual crops after that time, either of pulp wood, cooperage or crating material. An average cutting of 25 dominant trees more or less each year, should harvest all of the poplars well within twenty-five years from planting time.

At the same time such of the pines as may be found to be diseased, deformed, or defective, should be removed for the benefit of those remaining and should go along with the poplars each year, even though it reduces the average annual crop of poplars. The object is the best money returns for the yearly crop of woodgoods, with due regard for the prompt relief of the suppressed trees. The trees will have the benefit of all of the elements of mineral plant food for healthy continuous growth from the very start until the first crop is ready.

A mixed planting should be mutually helpful both on account of the different root structure; for securing various kinds of plant food, and moisture from the ground, and by the different character of their leaves in performing the same function from the air. All trees do not feed alike, and it is conceded that a mixture tends to increase growth and to protect each other from disease. Aside from all of those useful helps, it may be well "not to risk all of the eggs in the same basket," but last and not least, it serves to provide a rotation for a continuous crop while the real forest matures.

The pines, like all conifers as well as the Carolina poplars, have been restricted to their natural homes, simply because there has been no commercial demand for their spread by artificial methods for the reason that natural forest trees have been so plentiful and cheap that it did not pay to exploit them. But there is ample evidence through street, park, lawn and lanes, both public and private, so far as we observe, that there is hardly a limit to the area where they will thrive with intensive methods of treatment. Of course some species will thrive better in some sections than others.

Both the Cottonwood and Loblolly pine may not make the same growth in the far North, as they do in the longer growing seasons in the South, and for the same reason the white pine should get that benefit if artificially grown farther South. The root formation of conifers tends to seek moisture and food from below, exactly contrary to that of the cottonwood. The tendency of the latter is to find them through roots so near the surface as to often be scarcely in contact with the soil at all, which habit we hope in a measure to cure by shallow cultivation and the consequent root pruning to force the roots below the surface, in contact with more moisture than if left to follow the course of nature.

These two species of trees are selected for a successful growing rotation of the evergreens and deciduous trees, each requiring something in the way of plant food the others do not need, thus utilizing all as far as possible. In addition there is their commercial value, at every stage of their growth. Reference to that point will be more fully made after our method of intensive culture is explained, and quotations from official records will largely enter into the subject, which should cover every phase of all of the questions involved.

The basic principle on which we rely for the wonderful success we claim for the intensive method in planting, care and culture, is to tax the ground only up to its capacity, to start and keep the trees growing, just the reverse of the method of nature requiring a "thick stand" for self-pruning purposes only, that constantly overtaxes the soil. Our plan of annual suppression of limb growth by artificial means from the very start, makes cultivation possible, and by annual commercial cutting after ten years gives the remaining trees the benefit of more soil and plant food as their increased growth requires.

CHAPTER VIII

Annual Pruning and Cultivation Avoids Fires

WE have explained how our first twenty acres have been clean-cut of the standing timber, and of the preparation of the soil in advance of planting time. We have noted the preparation of the holes, and their inoculation and fertilization. In planting, pruning the side branches only, but carefully avoiding injury to the top shoot, (just the reverse of the practice in planting orchard, lawn or shade trees; in the latter we should give encouragement of limb growth to the very limit). In order to grow the largest bole or stem in the shortest possible time we prune timely, properly and persistently and thus secure a larger proportion of clear wood in contrast with the low grade knotty wood due to the slow pruning process of nature.

We do not need to tell a farmer how to plant a tree, for it is part of his trade to know how to plant anything, or to tell many of them how and when to prune, but we want to tell him the time has come to plant for profit and of the importance of a good stand of the right kind and of a good start for the young trees. He will thus accomplish in a few years that which nature's methods take ages to do. The only possible way to make forest tree planting pay is by intensive methods.

After the cultivation or disking just preceding planting too much care cannot be taken in preparing the soil in the hole for the reception of the plant, regardless of the little extra cost over the slipshod, hit or miss way. Later on we will explain the benefits of the lime, phosphate and potash combination, to give the young trees a good start, which is half of the battle.

As soon as convenient after the first planting, and after the first cultivation, eight hundred pounds of lime should be spread broadcast for quite another purpose than for the early start.

The cultivation with the disk harrow should go on as often as may be necessary to keep down the persistent vegetation that is prone to come after such treatment of the soil, the cost of which is relatively small compared with the probable results.

The kind of pruning that is the basis of the intensive system, begins at the very beginning a little at a time, before the end of each and every growing season. The time is of the utmost importance, as will be later explained.

At planting time, the outer ends of the lower limbs have already been pruned, at the end of the first year all of the lateral buds are removed and the top buds except the center one are rubbed off to secure an upright stem. At the end of the second year, all of the limbs of the first year's growth are cut close to the bark, with the same bud-rubbing process to prevent the tree from forking, and otherwise to preserve its form.

At the end of the third year, the lower half of the second year's limbs are pruned close, with the same care as to the terminal buds.

At the end of the fourth year, the upper half of the limbs of the second year's growth are removed, at the end of the fifth year, no limbs may be removed, and at the end of the sixth year, all of the limbs of the third year's growth must be removed; thus leaving the limbs of three years' growth at the top of the tree until the tenth year, when the growth of seven years will be free of limbs and therefore that part of the tree henceforth free of knots. The bud-rubbing process will also be practical on side branches that would tend to distort the shape of the tree. As so much depends on the quality of the material in the tree, that affects its market value, whether it is knotty or clear—all profits depend. To secure the better grade so little is required, but that little is the real thing that means success. Just a little at a time, "As the twig is bent, so the tree inclines."

By this system, no limbs would be more than of three years' growth, less than six feet long and but little more than a half inch in diameter, easily removed with ordinary pruners. At our spacing, the last lower limbs would all too soon shade the ground.

The annual cultivation would so cover the small limbs and other vegetation with soil as to hasten their decay—and thus leave nothing to burn. Our unusual spacing, 6′ x 10′, is to permit cultivation longer than if planted in squares—and to provide a better roadway for hauling the thinnings.

At this stage of growth, the hundred or more cottonwoods that will go to market in the next five years should need no further pruning—and after the next ten years none of those remaining need further attention.

At each five-year period, an additional year's growth of limbs should be added to the crown, thus at 10 years there would be four sets of limbs and at 15, five or more sets and so on. After that time, further pruning except for the selected few might not be practicable.

Four-year transplants, that is, 2-year seedlings, transplanted two years in the nursery rows should be in conifers more than three feet high and the broad leafs higher.

We would have to depend on the State's Nurseries at first for our transplants, until the seedlings growing in our own nursery rows also from the State's Nurseries, that is, we should always depend on the State for the seedlings as being cheaper and better than we could raise them at home, but the advantage of growing our own transplants for the quick transfer to their permanent homes is too obvious to call for comment.

After recovery from the first shock of transplanting with our careful preparation of the soil for their future home, growth begins in earnest, and with the constant further care, the rapid growth will continue. Do not be tempted in order to save a little first cost to transplant forest trees or trees from the forest. For there is a greater shock to such than to the nursery tree, which will necessarily retard its growth so much longer, even if planted carefully and after prompt removal from the forest, its growth will be so much slower than the nursery grown trees.

Such trees planted in 1873 have done well, but the same variety of nursery stock planted in 1883, had in 1893 passed the forest trees in both size and quality, that is, they grow twice as fast under the same treatment.

Seven hundred and twenty-six nursery transplants at six dollars per thousand cost $4.36—to say nothing about the difference in cost, the difference in handling would make first cost also in favor of the nursery stock. That is, gathering the trees from even a nearby woods would be much more expensive than to buy the nursery stock.

We have no object in view except to encourage growth by letting in the air, the warmth and the light of the sunshine.

Our system of pruning the young limb and by suppressing the embryo limbs produces no scar that one season will not heal, or no trash that one season of decay and the use of the cultivator will not destroy, and thereby practically fireproof the plantation so completely that there is actually nothing to burn, and no risk to run or insurance to pay. Thus is removed the one great obstacle to successful forest tree planting, the bane of the profession, the most expensive part of the system now confronting the National and State Service.

Without our faith in this system of artificial pruning this book need never have been written for three good reasons:

First, because the slow growth of the best species with a "thick stand," interest and overhead charges make profits impossible; *second:* if the first could be overcome, fires growing out of the "thick stand" would be such a menace that farmers could not afford to take the risk; *third:* with both of the other objections removed the quality of the lumber made from a "thick stand" would make it absolutely unprofitable. No artificial planting without artificial pruning can possibly pay a private planter. It is the annual (and not the periodical) pruning that insures clear growth, the paying intermediate crop, and without the intermediate crop tree planting could not pay.

This system of suppression of limb growth is perfectly understood by the nurserymen, grape and other vine growers, superintendents of parks, shade tree doctors and orchardists generally. It is quite inexpensive when taken in time (compared with the ordinary kind of pruning), leaving no scar to make a defect beyond the first season, pending which time growth only to a very small extent is retarded when practiced a while before the end of the growing season.

Before leaving this subject for the time being we again advise care not to injure the top bud, as we want to encourage the growth of the greatest height in the earliest possible time, to make a tall, clean, healthy tree, already trimmed, with little to do in timber getting but to fell the trees and saw them into logs with no branches to lop off. Usually the latter requires by the old method more time and labor than the other two operations, and is such a menace to the cut-over ground from fire among the dry tops and brush, as to make replanting too dangerous to justify the risk.

Our plan contemplates the two kinds of pines; they are planted alternately in quincunx forms on the first, third and fifth rows, and the cottonwood on the intermediate rows and so on. Scotch pines will only be used as a substitute when one or the other varieties may not be for any reason desirable.

This spacing might be greater than necessary for the first few years. However, none of the trees that might be included in a closer stand could attain a commercial size before the remaining trees would need the room to meet their constantly increasing demands. Thus the plant food would be wasted to no purpose and the cost of the useless plants, digging extra holes, and the expense of planting the needless ones. Thinning would then be an expense instead of the means of a net income. Our system of annual pruning overcomes the usual objection to wide spacing.

Aside from the benefit of cultivation already mentioned, the creation of a mulch by tilth, is quickly secured and much more effective in absorbing, controlling and conserving moisture than any other practical plan. It makes the soil more friable and aerates it, letting in the sunlight and heat, and bringing into activity those latent or insoluble elements of plant food so much needed by the tree, but largely unavailable without cultivation and the other helpful agencies of the new system.

The heat and air shut out from the ground by shade does vastly more harm, than a mulch of leaves could possibly do good, even if they did not have to wait a half a dozen years or more to accumulate a sufficient quantity to be of any good whatever.

By cultivation we incorporate so much organic matter into the soil, that we thus secure it for the benefit of the plantation instead of its being wasted by evaporation that so cools the soil that it checks growth.

We do not rely solely on cultivation to bring about the condition of soil referred to. That is one of the functions of burnt lime. Its chemical action is to correct the acidity of the soil, thus acting with potash and phosphorus as a leaven, and by the combination "the whole lump is leavened," by some chemical process of nature. Through the same elements of plant food latent in the soil but waiting the assistance that time or rotation seems to give, this may be seen in the yeast cake with "the staff of life," or to put it in a more homely way, like a seidlitz powder when mixed. With the aeration and heat that follow cultivation and inoculation, nitrogen direct from the air or through the leaves or both is let into the soil to make the plant food complete for the growth of the plant. The physical action of lime is for the improvement in the soil's friability, or its workable condition. With soil properly drained, prepared, and with good trees carefully planted, inoculated, fertilized and limed, nothing is lacking for good results but pruning, the process that is to force into the bole of the tree growth where it is wanted, and not to maintain an excess of useless branches and leaves to be wasted.

Were we growing trees for seed, fruit, flowers, nuts or leaves, the practice would be quite a different thing, but for forest trees, the clearest and most wood in the shortest time that will yield the most net money is what we are after.

We are not in the least concerned about the loss of the limbs and leaves, for the mulch they make, for the conservation of moisture for keeping down the weeds and briars, etc., or for the plant food in them, for we accomplish all those things in a way so much quicker, cheaper and better by tilth, avoid the fire risk, save much time and increase the quantity and improve the quality of the lumber, hence create value, make a profit instead of a loss.

If our ground from any physical condition could not be prepared and cultivated we would waste no time there in artificial planting. By intensive methods nothing but failures can come from halfway measures. It will be better to let it alone unless we be prepared to do it properly. The intensive system permits no short cuts to save first costs.

The quotations from the official reports of the Forest Service should leave nothing to guesswork; there every phase except annual pruning is well understood. Read them carefully before deciding to either approve or disapprove and without prejudice.

We now take up the question where we left off.

CHAPTER IX

Cost of Preparation, Planting, Care, Cultivation and Artificial Pruning

THE cost of drainage, dragging or disking and crossing the clear cut land, digging the holes, purchase of plants and planting the first twenty acres, already described, should be about ten dollars per acre, and pruning and cultivation thereafter should be less than three dollars per acre per year.

The details of these processes will be fully set forth later. This total cost is based on 726 plants per acre at six dollars per thousand for one- or two-year old transplants from two-year old seedlings.

The two-year old seedlings at three dollars per thousand to be transplanted in our home nursery rows, to grow there one or two years before being transplanted to their permanent places will be the practice later on.

After ten years the marketing of the cottonwood for pulp wood, cooperage or crating material begins, regularly increasing from year to year. The net proceeds from such sales of woodgoods will provide for all overhead charges as well as cost of operations and an increasing income annually.

We have no expense for thinning to make room for over-

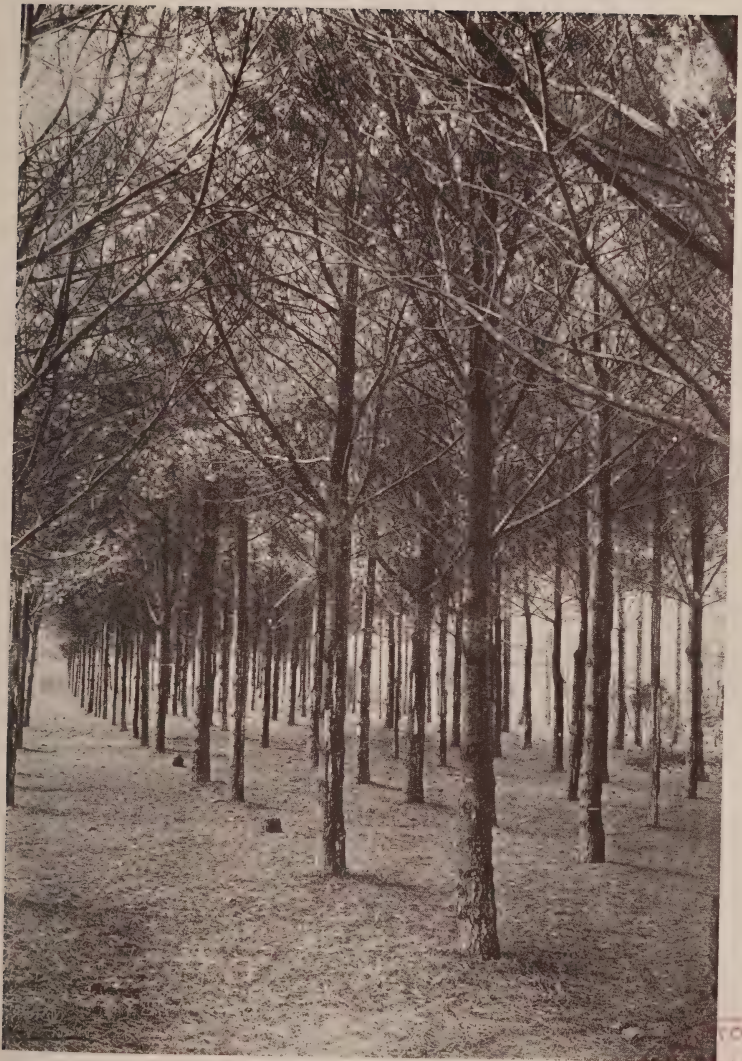

Photo by Courtesy U. S. Forest Service

White Pine plantation, 22 years old, on bare sand for reclamation purposes, East Greenwich, R. I. Thinned to 7 ft., every other tree removed at the age of 15 years.

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crowded trees. That object is accomplished by proper spacing and crop cutting for the market, the cost of which is deducted from the selling price. The selection of the cutting, however, is made either for the benefit of the remaining trees or for the purpose of getting the best money returns, the condition of markets and other circumstances being controlling factors. The prime object is to make a crop and not to make a forest except incidentally, but by the rotation to make money selling woodgoods, as fast as the trees approach the stage that yields the best results, and thus liberate suppressed trees for the better growth of those remaining.

The annual pruning process will continue as long as may be deemed profitable. A clear bole for thirty or forty feet is practicable with a proper outfit, which should be attained in ten or more years for the cottonwood and some of the pines.

The harvesting or cutting should go on at first at the rate of twenty-five of the largest trees more or less per acre each year, later on increasing until the end of the first twenty-five years from planting time. During that time there may also be cut some pines of both kinds for the same or other uses or reasons, while anything over five inches at the small end in any of the three woods will be merchantable, but only defects in the young trees will be cut down to so small a diameter. In addition to the wants of the paper making trade, long before that time there should be a demand for crating slats for fruit and other cases or packages of better material than from knotty wood and as all of these trees will be free from knots there will be a ready market for all from the very start (even if the demand of the paper trade and of the veneers or plywood should cease). Complete machinery for handling such goods is already available, portable, and at small cost. They may then be available in communities as are now threshing machinery outfits in grain growing regions.

After three or four years of cultivation, the soil should be in good condition for planting the permanent or ultimate forest that the rotation contemplates, in which there will be a preponderance of hard woods, though yellow poplar or whitewood will occupy a high place there, if not later on included in the selection or substitution for the intermediate or crop planting, especially in some sections where both White Pine and loblolly pines might be considered too risky, and the Scotch Pine not desired.

By that time this feature of the new system may become one of universal interest, according to location, one that will claim the most earnest attention of the scientist, the botanist, the nurseryman and the expert forester.

The question of selection has no special bearing on the merits of the new system. We will in the meantime make no mistake in planting besides the oak, ash, and hickory, the pecan and walnut, all useful woods in the arts and trade, for their capacity for yielding paying crops. The walnuts and pecans will fit into our regular spacing at the rate of about forty-five trees to the acre.

Such a planting can be varied at subsequent times of any of the new twenty-acre tracts as they are cleared and made ready for planting, which will continue to be in order in due course each year thereafter, as has already been explained.

The poplars, and then the pines, are the intermediate crop that paves and pays the way to the permanent plantation, or a real forest which is until then simply an incident of the tree planting trade.

By our annual pruning and then cutting, instead of the periodical thinnings, we keep in close touch with the whole plantation, for the seasonal bud rubbing practice, to control the form of the trees and the removal of any deformed, diseased, damaged or defective trees, all of which, after five inches or more in diameter has been attained within the first ten years are of such marketable value as will make them pay their own way, whether living or dead.

The process of cutting for market must be kept up the second fifteen-year period, just the same or faster, if the remaining trees from increased growth demand more room.

At the end of forty years all but the hard wood replants and sixty pines (tall, straight, free from knots, crotches, crooks or cross grained timber) will have been harvested. During the following ten years such trees should yield ten hundred feet or more each, and would be well worth in boards these days forty to sixty dollars per thousand feet, and there is good reason to believe they will be worth much more then.

In the meantime or during the first forty years, the intermediate crop of dominant poplars and pines at only pulp wood prices should yield a stumpage value of $1100 (but many of the trees will be of saw log size long before that time, and much more valuable), and the stumpage value of the sixty pines in the next ten years should be worth $1200 more (if of loblolly or if of White Pine very much more), equal to $46.00 per acre for each year during the entire fifty years. This will then leave a promising coming forest of hard wood and nut bearing trees long since in full bearing. During that time reproduction can take place by such further artificial planting of the hard woods as may then be deemed best. It is not our purpose to plan beyond our rotation.

In our estimate of cost we have made no allowance for insurance, and have omitted any expense to watch and fight fires or for steel watch towers, because we have fireproofed the proposition from the start by annual pruning and cultivating or by disking in or under the leaves, litter or humus. We have not allowed for cyclones, disasters of any kind or disease, because after they once become of value the defects would be the first to go to market, dead or alive and convert a loss into a profit and thus sooner relieve the remaining overcrowded trees. These results can only be attained by good management. The fireproofing applies only to the clean-cutting planting. The liberated young growth not having the benefit of early pruning, spacing and cultivation could not to the same extent be so protected. Yet operations will be so conducted with that end in view, that the risk would be gradually reduced as will be later explained.

In the course of the average farmer's ordinary farm work, with his own help, teams and implements, these estimates of costs would be very excessive, but the saving need not be too seriously considered in view of the possible large net results by the intensive system and through the economy of power, time and the first cost of superfluous trees required under old methods and needless planting. As history has a habit of repeating, instead of discounting the 1921 prices and costs the chances are largely in favor of the prospect that they will be at a premium and the costs at a discount long before the new crop arrives. These claims in the light of the accepted idea of woodlot treatment and results are so extravagantly radical that we must offer better reasons for "the faith that is within us," than our simple say so.

We have sought the official report of every state in the Union and several English speaking colonies of the British Empire, bulletins from the Agricultural Department of the United States Government, documents from a number of universities, colleges and schools having departments of forestry, and the best authorities in the land including accepted text books from which we make quotations and excerpts bearing on the subject pro and con. It is the truth we seek, and by this eclectic method the whole truth is garnered.

CHAPTER X

Cheapness, Quality, Quantity, and Protection from Fires by the Intensive System. Estimated Net Returns

LET us see where we stand and what we claim.

In the first place, there is a good, constant and profitable market for all of the woodgoods, large and small of commercial forest trees, and of those heretofore considered inferior woods that are now standing at "Lotuswood," whether cut over, partly cut over, or not cut at all.

Furthermore, by intense methods of culture and care, by artificial planting and annual pruning, quicker and better net results can be obtained than by nature's methods of a "thick stand for natural pruning."

Third, by clean cutting and prompt replanting of only forest trees of good healthy habits and quick growth, marketable woodgoods will be ready for harvest before all of the woodgoods now standing on the three hundred acres at "Lotuswood" can be handled on our plan of operation as already outlined, that is before the end of the ten years when the beginning of the first crop of the rotation of the new woodgoods will be ready for market in constantly increasing value for forty years more until the end of the rotation.

Fourth, by our plan of handling the woodgoods now standing at Lotuswood, there should be a net stumpage value of $108 per acre, at which price a generous profit should be left after all expenses of clean cutting, brush burning and handling the woodgoods, and of preparation of the soil for planting, plants and planting, fertilization, liming and cultivation for the first year, with no allowance for the fuel saved and stored for the lime kiln.

Fifth, the cost after clean cutting, with no allowance for woodgoods or fuel, may be safely estimated at ten dollars per acre when done by the farm hands, that is, in the event of the farmer selling his wood and timber on the stump to be removed within a certain time, for so much money—the allowance stated should be well within bounds. And the annual pruning and cultivation by the farm hands should not exceed three dollars an acre a year.

The maximum yield from the first forty years should exceed 220 cords of pulp wood, at a stumpage value of five dollars per cord, and for the next ten years a yield of sixty thousand feet of selected pine trees worth not less than $20 per thousand feet.

Any farmer with a stand of timber and as well located as that at Lotuswood, with the intensive system well managed, should do as well.

There can be but a few real questions involved in the practice at "Lotuswood."

1. Has a permanent change in the market conditions of woodgoods taken place?

2. Is there a ready and profitable market for wood-

goods now standing, including the inferior kinds and the smaller sizes heretofore unmarketable?

3. Can the timber be handled and marketed at our estimated cost and can it be sold at our stated prices?

4. Can we clean-cut and plant and care for as described at the estimated cost we claim?

5. Will our system of pruning improve the quality of the timber trees to the extent we claim?

6. Will the intensive system increase the growth as we claim?

7. Will it fire-proof the new plantations?

8. Will there be a ready market for the new woodgoods from and after ten years?

9. Will the new crop be ready in ten years?

On these questions depend interests of great importance to the peoples of the civilized world, in regard to all of which we stand ready to prove our claims. But unlike so many other questions, it is more difficult to prove because of lack of records, and it is too late to experiment, and expect to get proof from results in time to decide how and what to do. If we must wait for trees to be planted and grow and mature for proofs, it will be too late to avert a castastrophe.

Therefore, if the situation is really as serious as we apprehend, we must investigate through the only means open to us, get close to nature, study the history and the traditions of tree growth in the woods, at home, and abroad, with plain, ordinary, everyday, practical common sense, and decide for ourselves. It is our privilege to study and apply the scientific teachings of various schools of thought and from the official reports of the forest service. The sum total of professional tree planting experience and knowledge is herein available, as well as the system developed by the practical experience of this layman.

As heretofore stated, we approve the work of the Government in the case of its own Forest Reservations in the west, and the purchase of vast acreage of cut-over forest lands in the east, and its methods of restocking them; the movement is in the right direction, and will grow in usefulness for the benefit of those who will come a little later. But there is nothing in its practice that the ordinary farmer or private owner of woodland can adopt, although the lessons they have taught and are teaching should be a great public service, available to the farmer and private owner, that should encourage general interest in the subject, until our system is so improved by scientific and technical knowledge that it will be as "household words."

The awakened interest in so many states on the subject is also a healthy sign, a wholesome consciousness as to the seriousness of the situation, even if some of them are still following a cold trail as to natural reproduction or artificial planting that heretofore has sufficed with no further care. Time does not count with nations or states; but with busy, restless, everyday people it is quite a different matter for with them "time is money."

The plantings and nurseries in many of the western, middle and New England states are also movements that promise much for actual results now and in the time to come. The lessons they teach are near at home and they extend aid or are preparing to extend it in furnishing reliable plants on a large scale to their own people at prime cost. Many of them also seem to be fully alive to the importance of the question from a public as well as a private point of view. But so far, no usable advice has been given as to how to proceed, that offers a prospect of profit to the average farmer or private timber land owner.

The system of nature still advocated as the only one that is practicable, is now and has been as fully understood by the average farmer as by the trained forester. It was then acquiesced in because there was nothing else to do under conditions that then obtained, when so much good timber was so near at hand and so cheap. The farmer now knows of the changed situation and awaits practical instructions for action under the new order of things. It is for that reason we are explaining our new system.

As the time has come for increased production of wood-goods for the welfare of mankind (and it is well known that the methods of nature unaided are too uncertain and slow to meet the demand), then it is evident that some other method must be adopted; therefore we must break away from laws that so far have been harmless to the average farmer.

As it now appears, artificial planting is the only resource for the prompt renewal of our waning timber supplies, then the best practice in that line is of urgent human importance.

The first step we advocate in that direction is a complete emancipation from the antiquated theory of the "thick stand," the cost of the useless number of trees in excess of what the soil can successfully sustain, and of the cost of the slipshod methods of handling the superfluous ones, planted only to die before a marketable size can be obtained. Those that survive must wait from thirty to fifty years before natural pruning can be complete, before which time clear growth cannot begin; nor any growth worth while until the weaklings of the thick stand have succumbed to their fate. We must then be rid of the idea that any practice is cheap that accomplishes nothing. Artificial planting without artificial pruning is a "delusion and a snare."

CHAPTER XI

Artificial Planting and Pruning by Modern Methods. Natural Pruning

NATURAL pruning went hand in hand with natural reproduction when no better methods were needed. Artificial plantings for profit by private owners of woodland can be justified only through the most intensive system of pruning and useful aids and helps that the new system implies. No halfway measure can succeed in this kind of an enterprise, any more than could be expected in any other legitimate business occupation. But with no field crop on the farm can thoroughness promise greater reward than by increasing and improving the quality of the woodgoods and the value of its neglected woodlot. Pruning by our system is intended to accomplish several important purposes at one and the same time, without which tree growing should be a failure at the start. It is a very simple and inexpensive operation and such an innovation on what we have in mind regarding periodical pruning, the kind usually performed at the cost of much time and labor with the axe and saw, and with more harmful results than the system of a little at a time every year a while before the end of the growing season. The trees necessarily can have nothing but very small branches to be removed, and such buds to be pinched off as may secure a straight tree of good form without forks, crotches, crooks and cross grained wood. The transplants, two years old after two year seedlings, should have the lateral branches cut back to a uniform shape for the purpose mentioned after the two season growth in the nursery the summer before the time for planting, using great care to protect the top shoot and the proper shape of the young plant.

At the following or first growing season after being transplanted to its permanent location, nothing more may be done except to preserve the tree's proper form and such bud rubbing as may be necessary for that purpose. At that time the tree should be six feet high, with a clear bole of two feet. At the end of the next season's growth, the tree should be 10 feet high with a clear bole of 5 feet, and at the end of the third season it should be 14 feet high with a clear stem 8 feet; all lower limbs should be cut smooth and as close to the bark as may be practicable. The importance of the time of pruning cannot be overestimated, first, in order that the wound may be healed over before the beginning of the next growing season so the tree has no check in growth to overcome from this cause. During the months of July or August, the healing elements are in the wood to affect that purpose promptly, and thus quickly secure the benefits of the clear stem.

At the end of the fourth season, the tree should be 19 feet high with a clear stem of 13 feet. At the fifth season, 23 feet high and 16 feet clear bole. By this practice there should be in the crown three sets of seasonal whorls, until the 6th season, when the pruning may be omitted, so that there will be thereafter and until the 10th year, four sets of whorls.

After the twelfth year, five sets or more may be allowed to remain. This practice may be applied to the cottonwood and both kinds of pines alike. When the crop of cottonwood is ready to be thinned, pruning of that variety may cease then and thereafter. Two hundred pines should be selected for a continuance of the pruning process on such a plan as may then be found to be best.

If at that time, the white pines have escaped the blister rust or the damage of the beetle, they should have the preference over the loblolly pine. Should either have already developed and the Scotch pines been substituted, the loblollys should have the preference in the selection for the final rotation and the pruning then should be confined to the 60 selected trees only.

It will be observed that until the sixth year there should be no limb to prune more than one half an inch in diameter, and until the tenth year, none but a little larger. So the annual pruning is easily performed by ordinary pruning tools. Thereafter it is a question of cost to be justified by the quality and value of the product from such treatment, and a subject for future consideration.

The bud rubbing process for the purpose of controlling the correct form of the stem like the pruning should not be practiced until the growing season has well advanced.

Pruning to check the growth of wood for the benefit of the fruit or nut in an orchard tree may be all right, but never on a forest tree that we grow only for quality and quantity. Severe pruning while the buds are swelling should never be practiced on any tree for any purpose.

With our mode of spacing and pruning, the air, the sunlight and its warmth will reach the ground at some time every clear day, until the pine trees reach a height of about forty feet within about ten years. By that time with this intensive system, the limb growth may be allowed still more crown; space now continually will increase for the remaining trees by the annual cutting and harvesting. After the sixth year, the pruning will be done with special pruning tools. This may appear expensive but it is not so great in practice as it appears, but anticipated results are important enough to stand a much greater expense, if necessary, considering the difference between the value of clear and knotty lumber (a real question of profit and loss) if no other benefits would accrue.

By the twenty-fifth year after planting all of the deciduous trees will have been cut and sold, again making room for a new planting of some kind. In part, probably this would be an increase of pecans and walnuts or some other nut-bearing tree; however, that will be a problem for the future to work out. A few years ago the bugs attacked the oaks in West Virginia. A beetle from Europe destroyed the bugs and saved the oaks. We may hope for some such a cure for our chestnuts and locusts, both now under a ban on the Eastern coast. In that case a proportion of them may be in order.

As already stated, the spacing is unnecessarily wide to begin with and will be for several years. But a greater crop will for that reason be insured at the first cutting; it makes cultivation easier and to continue longer, and permits a wagon road one way between the trees.

Inasmuch as our planting is confined strictly to the clean-cut woodland, where cultivation will not be as easy as in the open farm fields, a field crop between the trees for a few years is therefore not practicable with us, as it might be if the planting would be in an open field, which we neither practice nor approve while so much wood land is practically idle.

The extra wood secured by cutting the stumps low and the better quality of the wood in that part of the tree would more than compensate for the extra cost of low cutting, and by the rapid method of pulling up the weed-woods, either by tractor, truck or team, the work will be greatly facilitated and cheapened. The wood so removed, otherwise unmerchantable, should be worth more than its cost for lime burning, which in the near future must cut a greater figure in soil improvement than ever before.

Seven hundred and twenty-six trees per acre is amply sufficient in the early years of the plantings. The productive capacity of the soil should be adequate to nourish all until the quick growing Carolina poplars, the "fillers in," have reached a marketable size—though small at first, being large enough for either pulp wood or crating material, for which there then need be no fear as to the demand or a decrease in price.

Our policy will be rather for immediate returns from the cutting than the supposed ultimate influence on the remaining planting. "A bird in hand, is worth two in the bush." The first cutting would be of the biggest

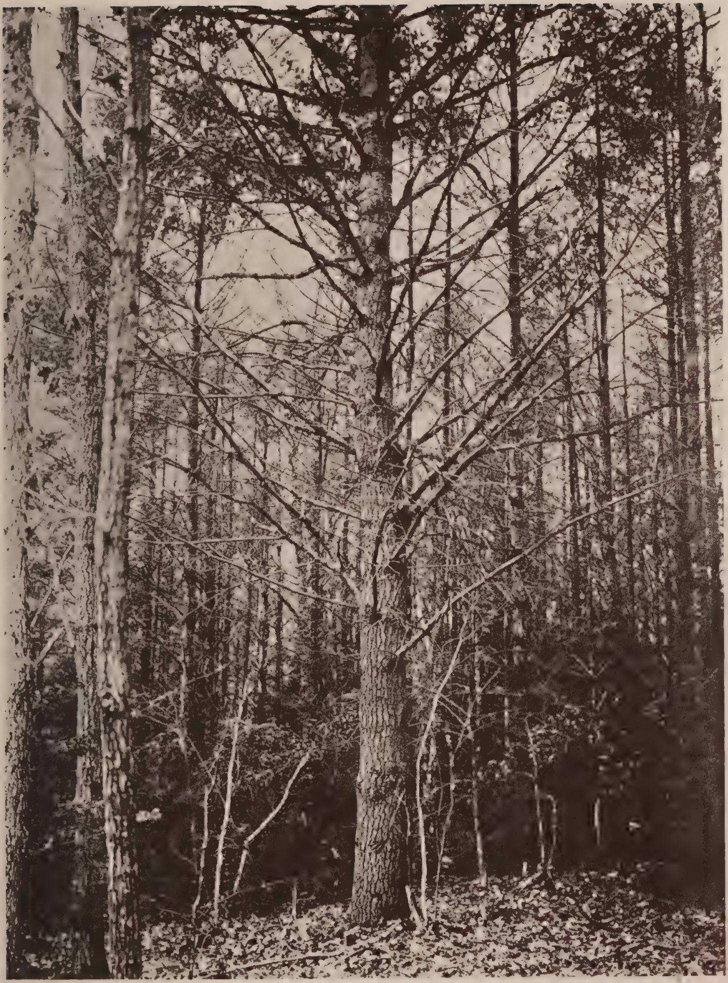

Photo by Courtesy U. S. Forest Service

Imperfect natural pruning of a white pine that stood too much alone in early youth, Milford, Pa.

and best as we would our cabbages, rather than the smaller and suppressed ones, as the best means of yielding not only the largest final returns, but the greatest annual money yield. Besides, the plan keeps the top growth more uniform. We are planting for a crop of woodgoods in the shortest time, with a real forest at the end of the rotation.

The policy is contrary to established ideas based on making a forest only, while our idea is based on making money out of a crop of forest trees on the idle woodlot and that depends largely on the annual yield of the intermediate crop. We hold that the yield will be vastly increased by annual cutting and shipping rather than if cutting is deferred to maturity or periodically, with any system of spacing, and any other method of pruning. If maturity is at twenty-five years for the cottonwood, it will increase by cutting more and more each year almost to the very last and the total yield should be many times greater than if left for a final cutting without the intermediate crop.

Of course, with this wide spacing, must go artificial pruning to insure quality, just a little every year that causes no shock to the tree like that of severe periodical pruning. All authorities agree as to the necessity of pruning for one purpose or another, the only objection offered to the artificial kind being the so-called prohibitive cost. We have counted the cost of our method of early and persistent pruning of needless limbs, and by the bud pinching process, for the suppression of the embryo limbs, as being so much easier on the tree and so much cheaper and better than any other method, and a large saving of the overhead cost. There is a time to prune and a time not to prune.

Thus a forest tree pruned before the summer growth is over produces a clear, straight tree, without forks, crotches, or cross-grained wood, without checking growth. Even our crating material from sticks five inches and up should be free from knots for high class fruit cases. Even if the growth were not increased by cultivation the result of the artificial method of pruning would produce a difference in quality alone which would pay all of the costs many times over. With the pruning, however, the advantage does not stop with quality alone, though it is only one of the many factors in the intensive system, that so increases the yield as to make the proposition a profitable one even if the quality were not so improved. But when a system increases one and improves the other, and saves all from the ravages of fire, what more could be desired?

Preparation—thorough, painstaking preparation, in which drainage is the first essential—is the primary factor or the first step in the success of intensive culture of forest trees. Yet with a special disk harrow, made extra strong for hard usage, any farmer knows how comparatively inexpensive it is, either with a good team or tractor to disk an acre of ground. Plowing is impracticable on our clean-cut land, because of the stumps and roots. Disking will be quite sufficient, and will continue to improve the conditions of the soil every year by repeating the operation.

The main object at first is to kill the vegetation and improve the texture of the soil by tilth to conserve the moisture; deep tillage is unnecessary. While the sites for the trees should be carefully crossed each way to make hole digging easier, it is desirable, but not absolutely essential, that every hole must be exactly at the crossing. A stump may be avoided by moving the transplant to the right or left, as the case may be, without interfering seriously with cultivation.

Such a suggestion would not occur if the planting should be in a clear field, but as we have no ground of that kind for such purpose, and so much of the clean-cut timber land, we are simply explaining a practical situation that we have to meet in the most effective and economical way open to us, and a problem the public must always be interested in, that is, not to decrease the food producing acreage, so long as population is on the increase.

Even though it costs more to dig the holes and prepare the soil than in the cleared farm land, we shirk not the extra cost of doing it right, for in this intensive system, all is in vain, if half done in any of its features for the sake of a little first cost, and inexcusable false economy.

Another important factor, but not absolutely essential, in the system is mixing the fertilizer with the soil. An ounce to the hill or hole would be quite sufficient, to give the young plant a good start. The omission of the nitrogen is due to the presence of the lime, we get that by other means. They don't work together; the lime now is the more important in the combination, at the start. Nor do we count as an economy to say how many trees a man can plant in a day; how many can he properly plant is more important, or how many successfully survive is what counts? With our intensive system, every factor should be given the fairest and fullest chances for success, for the omission of one may be fatal to complete success. The woodgoods sold from the clean-cut land provides the means to do the work and do it right; it would be indefensible to take any short cut to save a little first cost, if maximum results are aimed at.

All of these things should be carefully considered by the farmer, the owner of a woodlot, or the private owner of wood land before undertaking the task. The conversion of your woodgoods into money calls for management. Cutting out the speculator and the middle man and their profits is quite an important item, one that any intelligent farmer is capable of successfully accomplishing; there is no more mystery in that or any other part of the wood trade than there is in the management, production and sale of his other crops.

The percentage adopted by us at "Lotus-wood" that is, 10% per year, to clean-cut, prepare, and replant, should call for but little extra expense that will not be promptly returned if the farm is operated on a business basis. If the woodlot is small, then co-operation with neighbors might be desirable, both in handling the saw timber and in utilizing the weed-woods for lime burning. However, that part, in many instances might be better managed by contract with the portable saw-mill men or at least, in part, even at the expense of a longer haul to his mill.

CHAPTER XII

Proper Spacing, Mixed Planting of Commercial Forest Trees, White Pine, Loblolly Pine, and Cottonwood

LOBLOLLY pine as used in this work is one of several varieties of pines well known commercially as North Carolina pine in this country, and in Europe for the last thirty years. We have here adopted the name by which it is known to the profession instead of the one known to the trade. The latter makes no distinction in favor of one variety of shortleaf pine over others for the reason that rules of inspection govern, the grade is all they want. To the planter and the mill man it is a matter of very much importance, as, of all the varieties of shortleaf pine the loblolly is a quicker grower, a softer wood of better texture and a larger percent of better grades than any of the other varieties, under usual forest conditions.

There was a time when the question of a name had become one of real importance to the trade. After its market began to enlarge, which culminated a little less than forty years ago, when it was formally christened North Carolina Pine, that name was agreed on in our Baltimore office after several conferences with a number of manufacturers and dealers in that wood, as is now well known to the older members of the trade.

While the market had been largely a local one up to that time, the trade knew it as well by any one of its several names as another, but when a market outside was sought it became another matter. It was then a many-sided one. While the name of "Carolina Pine" was strongly urged by some, it would have been adopted but for the fact that Wilmington and Charleston at that time had a trade for a lumber of that name, which many called yellow pine, that differentiated it from pitch pine, long-leaf or Georgia pine. To many it meant a name for any lumber of the pine kinds that grew in the South.

Any of these names would have improved the reputation of the pines known as the Maryland, Virginia, Eastern Shore, Delaware, sap, loblolly, bull, spruce and old field pines. They were all used as a term of reproach by its competitors, the white pine people of the North, and at that time it was well known that the future supplies of that wood for the Northern and export trade would soon come largely from the state of North Carolina.

So after the last conference on that question the first invoice for loblolly shortleaf pine was made in our office in the name of North Carolina Pine, a name which has stuck to it ever since, and is now well known far and wide as such. A few years later the addition of K.D.N.C.P. stood for kiln dried and A.D.N.C.P. stood for air dried North Carolina Pine of the same wood. All of the larger operations were of the kiln dried kind—the only proper way to handle it on a large scale for the export trade or the better grades in the domestic trade.

While the proper handling called for a very expensive plant, it enabled the mill whose logs were often cut the day before a hundred miles or more away, to deliver the product sawed, kiln dried and loaded on cars or steamer all within less than one week, and insure their arrival at destination in good condition.

The adoption of the few commercial trees we have named, for our own planting was to avoid too many details and to simplify our recommendations. For the present, notwithstanding the scare of the "White Pine beetle" and "Blister rust" we do not hesitate to recommend the combination for planting. We doubt if any tree can be found entirely free from danger of disease of some kind, but that would not deter us any more than would the danger of hog cholera justify the advice to cease to raise hogs. Besides we are not sure that the milder climate of the lower latitudes and elevations, with the consequent earlier growing seasons and the mixture with other healthy varieties would not greatly ameliorate the trouble. Besides they may soon be controlled by Government experts.

Red heart is a long and shortleaf yellow pine disease, the outward evidence of which is punk. Such tracts are frequently found in natural growth often to the sorrow of the inexperienced lumberman. We would have no fear of it in artificial culture which included good drainage.

Such cases could always be traced to a local cause, likely over a hard pan that held too much water a part of the year and too little the other part, and from many other causes. Even the cottonwood has its enemies not infrequently stripping them of leaves, but it never seemed to do them permanent harm.

Much could be said in detail of the replanting of the clear spaces after the removal of the poplars, in planting the nut trees, but these particulars should be governed by circumstances now too far away to have any place in this part of the work. The main thing is to do the safest thing in the shortest time in the best possible way. The varieties of the pecans must be carefully considered with reference to climate before acting.

To that end we will at first, at any rate, stick to our combination and later more fully describe the advantages of the cottonwood. We have sought assiduously for official data as to the rate of growth of forest trees from artificial plantings and pruning with intensive management with little success from our state foresters, but with better results from other sources of information far from home.

A grove of loblolly pines is still at the U. S. Naval hospital grounds at Portsmouth, Virginia, where they were apparently at their best thirty years ago. A grove of pines at Lafayette Park, Norfolk, Virginia, young and vigorous, past the sapling stage twenty years ago, then well pruned by natural process, both good object lessons for the student, but in both cases, they are nature's production.

An artificial planting of loblolly pine I knew forty years ago, planted for a convenient or near-by supply of pine needles known in various localities by the various names of pine shats or shatters, pine straw or litter, pine leaves and rushes. The latter was the name more familiar to me.

They constituted an important aid in maintaining the fertility of the farms and in production especially of white and sweet potatoes.

This planting was spaced about 10 feet square, a perfect stand, and artificially pruned about ten feet high, to permit the team and cart to pass between and under the trees to gather the rushes or needles, which were raked together in piles and hauled away every season. The crop was always abundant, with no apparent damage to the grove from the loss of humus. When I last saw it, it was about 12 inches in diameter, and a mass of limbs and leaves; that grove has long since yielded to the axe and saw.

A local tradition concerns a well-known growth of the same kind of pines at Wyetown, in a field that was said to be in corn when the British in 1814 under the command of Admiral Cockburn ravaged the shores of the Chesapeake, and burnt the home house "Wye." We knew that field as a remarkable one of pine saplings forty years after it was a cornfield, well set, tall, straight and fairly well pruned. Thirty years later we cut that timber, which averaged in excess of a thousand feet to the tree, the thirty-three acres yielding two million feet, or sixty thousand feet per acre, from less than sixty trees to the acre. The ring growth showed an age of about seventy years and a fairly clear growth after forty years, indicating it had then nearly pruned itself.

Another woods that we were very familiar with seventy years ago, afterwards cleared of its saw timber and naturally re-seeded, is now a very interesting object lesson on the subject of growth, tall self-pruned, straight, clear boles are still growing, and should now yield thirty thousand feet to the acre. They have been thinned artificially but slightly, only for farm use. The owner is quite independent and they will likely grow profitably twenty years or more which should increase the yield of clear wood when such timber will be very rare and dear.

But even with the quick-growing loblolly pines, it is evident that a better method than natural reproduction must be resorted to, to supply present and the near future needs. That may promise profit for private planting.

White pines planted in bare spots among loblollys prospered in a neighboring forest, in the coastal plane far south of its so-called natural habitat. They do well as lawn trees, and thrive in the parks, in the South, but are not indigenous to the soils of the Southern states, except in the higher elevations, probably from the same reasons that loblolly is not generally known in the North, because the trade did not then need it. White pine is very slow in shedding its limbs by natural process; even in very thick stands half a century will be required. In parks, lawns or lanes where they stand alone no clear growth can be made within one hundred years, except by early artificial pruning.

Our selection of trees for "Lotuswood" of white pine, loblolly pine and Carolina poplars, are all of commercial value and in great demand. That should make a rotation of quick growers in the order named, reaching a marketable size well within ten years, by which time the now standing timber and woodgoods there shall be out of the way.

Cottonwood or Carolina poplar was known to us as a nursery tree first about fifty years ago, and by the latter name it is generally known East of the Mississippi Valley.

Botanists are inclined to the opinion that they are the same, they also think they are native of that region. We were of the opinion that they were imported from France, tradition says first to Monticello. Late in the eighteenth century, Lombardy poplars were very common and in full growth by artificial planting, tall stately trees of very commanding appearance. Few Maryland plantations were without them in the late forties and early fifties, but as such they did not perpetuate themselves, and those from suckers were but short-lived.

A very handsome grove at a farm near Wye, apparently forty years old, died out entirely in the seventies and a new planting prospered for twenty years, attained a size of sixteen inches in diameter and seventy feet tall, and then died. They were replaced by the Carolina poplars, which are still prosperous. It is said those of the importation were only of one sex. A cross apparently between the cottonwood and the Lombardy poplar may have been Burbanked to produce the Carolina poplar, which is said to be of the male sex, or it may have been introduced in Louisiana during the French occupation prior to 1804. A tree very similar in appearance is quite common in France and Belgium especially on their highways. It is said there that it has been much improved by propagation, especially as to its rapid growing habits. There the tendency of the limbs is to branch upward more like the Lombardy. The texture of the wood is like our Carolina poplar.

It is not a desirable tree for a lawn, because of the disposition to sprout or put up suckers from the roots. The roots (unlike the pines spread near the surface of the ground) frequently are so near as to scarcely touch the soil at all. Cultivation tends to correct this objectionable feature if taken in time by which they are forced deeper into the soil in closer contact with the moisture below and at the same time vegetation is suppressed.

Its commercial value has only been fully appreciated in the last thirty years, and under present day conditions is becoming more and more so, not only for lumber for many special purposes, but particularly as material for crating and packing cases. The very smaller sizes are profitably handled with special machinery provided for those purposes also for excelsior, and last but not least for pulp wood, for which there is a steady and growing demand.

A wood equally as useful as gum for plywood or veneers, the supply of that wood at present rate of consumption will soon be like the pines of the East, and except in unusually favorable situations gums are very slow growers. So in the natural order of things it is "the survival of the fittest" that counts, another reason why we have adopted Carolina poplar.

Cottonwood will likely be its commercial name as time goes on, and it will fill a place in our domestic economy for many purposes second to no wood we now know of except the pines and yellow poplar, and to a limited extent the oaks and some other hardwoods.

We have seen those cottonwood or Carolina poplar logs in the mills on the banks of the Seine, in the very heart of the city of Paris, long after the healing of the scars of the Commune that followed the German Invasion of 1870.

In the late '90s, we saw them hauled direct from the stump from a new growth that started on the fortification after that war—and sawed into boards at their little ground band mills.

Each log was numbered and each board had been inspected, measured just as they came from the log and entered into a book for that purpose like a tally sheet, so that the office had a record of just what each log contained. Dried by a peculiar process they were to be used largely for cases for champagne bottles, said to make a stronger case for its weight than any other wood so used.

We know of those same kinds of poplars, planted a little more than forty years ago, that will now produce three or more cords of pulp wood each.

White pine is well known all over the civilized world as one of the most valuable all-purpose woods naturally or artificially grown. Its home extends from Nova Scotia to Georgia, and West to the Rocky mountains. But little of the original growth is left standing, and the second growth, because of the slow process of natural pruning is very rough and knotty being suitable for boxes and common joist, scantling, and other coarse material. We know of no tree that would be benefited more by artificial pruning if taken in time. It is easy to propagate and responds promptly to good treatment, and it is adopted by several states for artificial planting, notwithstanding it is being threatened by the blister rust, a supposed controllable disease, and a beetle that is being scientifically handled by specialists of the National Government.

It is found in the higher elevations of the South as its natural home, but is frequently seen artificially in successful growths in the coastal plain, alone and in mixture with loblolly pine. Our observation there encourages us to the opinion that with the earlier growing season of that section, even if planted alone, it should resist the disease referred to, so far unknown there, and should make a more rapid growth than on its native heath. The same as may be said of the entire mixture, or in fact of any of our forest trees, because of the milder climate.

In the more Northern states, a mixed planting of Red, Norway or Scotch pines with White pines is much recommended, but as they are all of slower growth, and of lower grades the mixture with the loblolly we think would be more desirable in most cases. We have never discovered it to be liable to injury from severe cold weather even below zero.

Our loblolly pine must not be confused with many other pines of the various shortleaf varieties, most of them of comparatively small commercial value and of very slow growth, locally known as jack pine, fox tail, old field and bull pines, as well as a certain kind of pitch pine known to the foresters by that name (but not the pitch pine of the South), both at home and abroad it (Jack Pine) is largely in use in England as pitwood, or as mine props as they are known in this country. Before the war scores of ships could be seen at the docks at Cardiff and Swansea, Wales, and in the east coast mining ports of England waiting their turns to unload their cargoes from the sands of Gascony and Brittany. During the war that supply was cut off by the U-boats, necessitating great inroads in Great Britain's home-grown woods, that proved to be such a wonderful reserve supply in their time of stress without which the British Navy might have been helpless.

The same variety apparently is sent down the Rhine and up the River Main to Frankfort, in rafts from the Black Forest in Germany and there converted into lumber by the same primitive method of centuries ago. Staid old London near the shadow of its famous Tower had in one timber yard twenty-seven of those whipsaw outfits in operation at one time.

The identity of this wood seems to be unsettled by the botanists, but commercially there is no recognized difference in several varieties. The rules of inspection govern. It is rarely that anything better than a number four is found; it should be suppressed as a weed-wood because of its slow growth and low grade. Loblolly pines would now fit into the needs of Europe and its colonies as no other wood I know of, as a tree for reforestation of its devastated forests.

The original home of the Loblolly (Pinus Taeda) pine was in the Tidewater regions of the Chesapeake Bay and along the shores of its tributaries, and later of Eastern North Carolina, naturally taking the place of the long-leaf or pitch pine of the South, and is becoming more common in the far South, even along the shores of the Gulf to Texas, and up the Mississippi River to Missouri.

In these sections it is too well known to be questioned, and I predict it is destined to spread to the four corners of the earth faster than any tree now known.

While its output in the form of lumber has greatly increased and much study has been given to it in recent years by technical students of forestry, little is known of its history, of where and how it originated. It is by no means certain that it existed in any quantity anywhere before the coming of the English Colonists to the shores of the Chesapeake Bay, and its tributaries three hundred years ago. The lumber, clap-boards, shingles and naval stores shipped to England in those early days was from the long-leaf pine then common to the south bank of the James River if not farther North,—now with scarcely a dozen forests of that variety, large or small north of the Tar River and very few north of the Neuse in North Carolina. Between the James and the Potomac rivers and along the shores of the Chesapeake there was a tree then common but now almost or quite extinct known locally as heart yellow pine and in some sections as Rosemary Pine, to others as the navy pine, tall, straight; truly a majestic specimen of tree growth; in my time rarely more than half a dozen trees to the acre, more often only one, none except the matured trees, one hundred or more feet tall and thirty to forty inches in diameter, containing from two to four thousand feet to the tree soft straight grained wood, with only two to three inches of sap wood, probably three or four hundred years old, with evidence of having shed their lower limbs in the first half of their existence. They were common seventy years ago, rare fifty and now practically extinct; leaving no trace through a

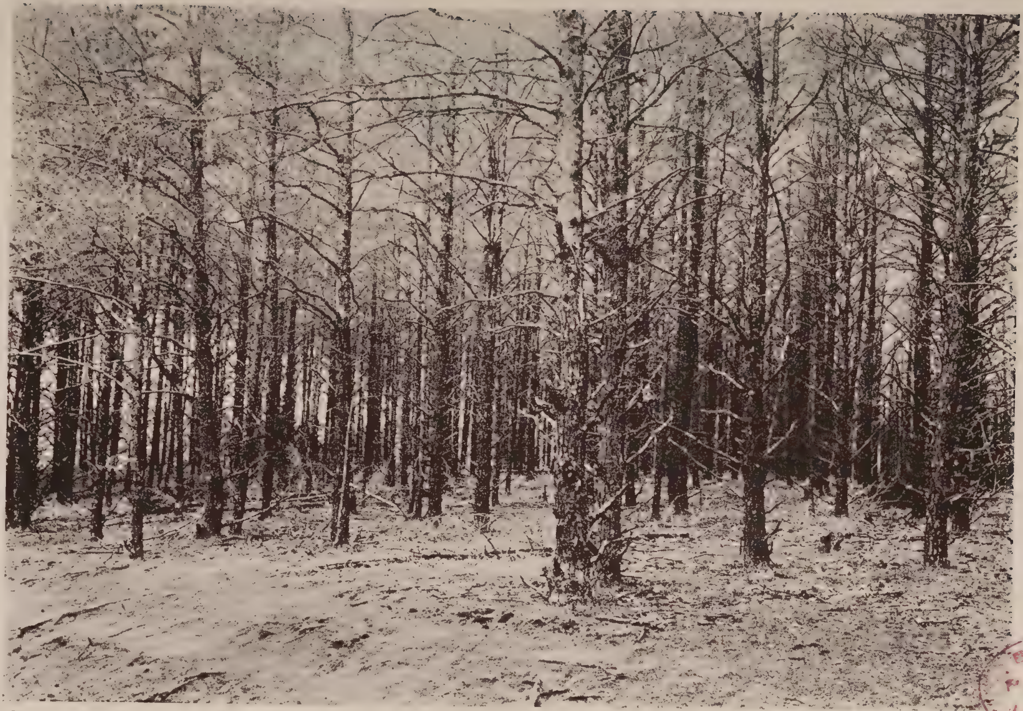

Photo by Courtesy U. S. Forest Service

Interior view of Scrub Pine, Calvert County, Maryland.

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second growth, that can be recognized as the same variety in the region that is claimed to be the original home of the Loblolly pine.

Unless they attained by some freak of nature the size and description of quality named during their long lives, what they may have been in their earlier years must be left to conjecture. Yet it is not impossible that their seed may have under certain conditions produced a second growth of some other variety of shortleaf pine, though the outward evidence seems to be against that theory for the reason that pinus teada is not supposed to attain such an age.

The spread of the loblloly tree into the region of the longleaf pine, seems to follow the removal of the native tree sometimes following the broad-leafed trees also. Unlike the deciduous trees, the conifer is not distributed by the birds. This in a measure accounts for the slowness of its spread to other sections, as it is known to be easy to propagate in a new home, either from seed or plant and its health is remarkable. If not originally included in the God-given heritage, then waiting for the newcomers from overcrowded Europe two or three centuries ago, it may now have a mission to his people and in the centuries to come, a timely "arrival of the fittest."

I have not studied trees with the microscope or callipers, or in the laboratory, mine is only a practical knowledge. I fear we all know too little about the history of trees. There is no evidence that varieties do not multiply and that species have not changed into many varieties, in the centuries passed and gone.

The Cedars of Lebanon of the days of David and Solomon and the Cedars of today are thought not to be the same. Then so plentiful, now so scarce. Historians tell us they were quite extinct in the sixth century, and at no time in the 16th, 17th or 18th centuries could but a scattering few be found in all of that region where they were so plentiful thirty centuries ago. In the nineteenth century they are reported to be reforesting by natural process, in which the birds may have played a part.

Nature has provided for the various epochs for the wants of the human race in her own way, and its provisions have been most bountiful. Though there is no lack of evidence that many forest regions have become treeless and many treeless countries have been reforested. All of this may or may not have anything to do with the new system of artificial reproduction. We have much to guess at what occurred in those benighted days. But in these enlightened days, with the aid of history, science and art, the limitations of what nature may do is yet undreamed of in its ability to preserve and advance the welfare of her own, so rapidly increasing that conservation alone is no longer sufficient, but selection for the production of the largest yield in the shortest time and smallest space at the least expense by artificial means is the need of the hour.

To that end we must begin sometime to eliminate the scrubs, the weeds and the inferior kinds. We have made progress with grades in animal life, the intensive process is now well under way, and will never go backwards.

So it will be with the vegetable kingdom, the plant kind; there is where the microscope and the laboratory will come in. In the meantime the practical farmer can do much in grades of trees as they have in animal life. Without splitting hairs while waiting for perfection, we will leave to the technical scientist plenty of work to do to improve on our own system.

Our selection may not be the best even for the next generation, but now it may be epochal. And with our modern system the millions of farmers in their woodlots can meet the coming needs and at the same time reduce the acreage of idle land, or increase the clear farm land by the intensive system of both forest and farm that more acres can be reclaimed for crops and then leave plenty of land for trees.

There is no good reason why the botanists may not improve the grade of trees, and increase the varieties. There should be no more room for a scrub tree than a scrub cow.

A planting of black walnuts, fifteen to twenty years old that we know of, has reached a diameter ranging from six to seventeen inches and a height of thirty to fifty feet and all of them are now in bearing.

A planting of pecans of forty-five years ago has been bearing for thirty-five years, and from those trees the second generation have started from their seeds or nuts, and are bearing. The third generation is now well under way from that original planting.

They (the original planting) had the benefit of the intensive system. To get back to "Lotuswood." As already stated the young poplar for pulp wood and some pines will be thinned out in time for the replanting of the hardwood and nut bearing trees. Later on the plantings will include these and others, but at the start it is needless to cumber these pages with generalities or what we may do. We are giving our experience here for what it is worth, in order to attract the attention of the outside world to work of this kind to invite criticism for the benefit of this and the coming generations.

CHAPTER XIII

Mulch by Tilth. Conservation of Moisture by Cultivation

WHILE a tree plantation cannot have the benefit of a farm rotation, the next best thing we can do is to provide a mixed variety of trees, requiring different elements of plant food and methods of securing and retaining moisture, either by or through their varied leaf and root formation or by their different means of securing plant food from the air and the soil.

It is conceded that practically all of the elements of plant food necessary for plant growth are already in the soil and air, which may be liberated by some other agency to perform the function designed by nature. How to help nature is the question the scientists have been seeking to solve.

Some say lime will make soluble those elements in the soil, others deny it, still others hold that it helps other elements by combination to accomplish the desired result. It has been demonstrated at Dubois, Illinois, after sixteen consecutive years of experiments, on a gray silt, that lime alone increased the average of a corn crop on poor land without fertilizer from fifteen bushels per acre only one bushel. The average of wheat without fertilizer increased from six bushels to sixteen bushels per acre, showing that lime is better for wheat than for corn.

Lime, phosphorus and potash in combination at the rate of one thousand pounds of lime and fifty and sixty pounds of phosphorus and potash respectively, increased the corn crop from fifteen to thirty-seven bushels, and the wheat crop from six to thirty-two bushels per acre, showing the combination to be a complete agency to produce or cause the latent elements to produce. Lime and potash increased the yield of wheat from six to twenty-seven bushels, only five bushels less than the complete combination; and the lime and potash on corn produced only a crop of fifteen bushels—this was absolutely worse than nothing. So it is evident that what helps one thing may do no good to the other, and it is for that reason that we take no chances when using the complete combination which has proven to be beneficial in both cases.

It should be understood that even at the high prices of fertilizers in 1920, it was comparatively inexpensive, for when we consider we are using only 65 pounds to seven hundred and twenty hills or holes to the acre, instead of broadcast as for both wheat and corn, the cost is insignificant compared with the benefit of the good start the plant gets from such an application.

It is not claimed that the quantity of these two elements of mineral plant food could have in themselves accomplished those results, but through the chemical operation of the lime on them, a larger proportion of those elements lying dormant or insoluble in the soil was brought into action. The "how" we will not attempt to explain, nor how the same combination in connection with lime and good tillage and inoculation will develop in the roots of the plant the bacteria that in some mysterious way draw the nitrogen from the air, thus making a more complete plant food without neutralizing its effect by combination with lime.

Our experience has been in accord with these experiments. Together with good drainage and thorough tillage, maximum results have been obtained when used in a sensible rotation.

It is for that reason that we mix the deciduous with the evergreens that their different structure may be mutually helpful. It is here besides the several other useful functions that cultivation comes in. One of them, not the least, is forcing the surface roots of the poplars deeper in the ground in closer contact with the moisture and plant food below by root pruning (so-called) thus giving them more drought-resisting capacity, especially in the early years of their existence. Otherwise following the lines of least resistance they would stay right on top of the ground, with scarcely enough soil to cover them.

Another very important duty cultivation performs is to break the crust to let in the air and the warmth of the sunlight and thus help take from the air the nitrogen needed and leave the latent phosphorus and the potash in the soil to work out their will in their own way. Last but not least, cultivation kills the weeds, briars, sprouts and suckers, all of which rob the trees of plant food and moisture so essential to their growth. By the fine tilth of the soil through cultivation a mulch is prepared that most effectually controls and conserves the moisture, and helps to secure and convert the mineral elements for the benefit of the trees.

With all of the care of preparation, planting, etc., all would be in vain, for without the early regular seasonal pruning, cultivation would soon be impossible. With it every cost would be fully justified; without it, there would be no prospect of profit, but a serious loss of both money and time.

The lime spread broadcast after the planting is for quite a different object. Its chemical effect is to correct the acidity of the soil, its physical effect is to help cultivation by making it more friable, easier to work. It stiffens the light land and lightens the stiff lands. Should it be desired after five years another application of lime may be applied. However with the carrying out of our other details the lack of lime should not seriously interfere.

Pruning by our system is a methodical means of raising forest trees of good form and healthy growth to produce the maximum of clear wood in the shortest time, at the least expense, beginning with the young tree in the nursery and following it up annually, as long as profitable results may follow.

This system we find is unknown to the foresters, as applied to forest trees, and with us is used only in combination with all of the various aids to profitable tree growing of our intensive system already fully described.

There is apparently a large majority of those in authority and who are supposed to know all about tree growth who caution against our system on the general idea that we are robbing the tree of necessary leaf growth by what they deem excessive pruning of limbs—a conclusion they arrive at by force of habit, on the assumption that certain theories are facts without an effort to investigate.

We, on the other hand, by our gradual method of removing the useless limbs a little at a time, promote the growth and health and improve the form of the tree and lay the foundation of raising a better one, by a method so easy and natural as to produce little or no shock to the tree nor create a wound that will not be healed before the beginning of another growing season.

All pruning should be for a definite purpose, and should be performed in such a manner and at such time or season as to properly serve that purpose.

The artificial pruning of forest trees primarily has only one object in view, that is, to make a better tree, to permit cultivation in order to make a bigger tree in a shorter time, and thereby to remove the menace of fire.

There is a kind of pruning that the authorities here quoted dwell on at considerable length but do not recommend its use. It is what they term periodical pruning of forest trees.

That is, by lopping off with an axe or a saw large limbs, at various times, ranging from ten to twenty years.

Such a system is a thoughtless, reckless and expensive one that is injurious to the health of the trees, retarding their growth and producing wounds from which years will pass before complete recovery can be expected, with a mass of dry limbs and litter that greatly increase the fire risk.

This treatise on our system of reproduction of forest trees, only incidentally applies to such growing trees in the woodlot as may not be intended for the clean-cut and replanted plan, as we have described at Lotuswood.

We will proceed to prune them in the same considerate manner, and at the proper season by removing the useless limbs that already have served their purpose, a little at a time, first on the smaller trees, such limbs, branches or forks that tend to distort the shape of the tree and such lower limbs as have performed their proper functions, not exceeding the growth of one year's limbs, thus early and easily preparing the way for a more perfect tree, while at the same time that tree (being selected as the best specimen of the proper kind) should be relieved from the struggle for space, light, and air, but on the same careful and thoughtful plan, of a little at a time, so that no violent shock will endanger the success of the tree, and thus, both the pruning and thinning of those small trees goes on from year to year, increasing both height and diameter growth at the same time.

After the care of the smaller trees of the proper kind, the lower limbs gradually, a little each season, so balanced as to control the erect form, then the trees of larger growth a little at a time, after the removal of the dead limbs—then the diseased or distorted ones, then the lower live ones; prune close to the bark to secure clear wood as soon as possible.

In this work we follow no set rules, except as to the time of pruning. We are only caring for a situation as we find it there, and are governed by special requirements of the individual tree and its surroundings.

The tendency of most trees is to grow upright, but like many people some will be inclined to grow crooked, either from the nature of the tree or its environment, or from outside interference, by vines or other bad neighbors.

A tree may be too crowded on one side—that involves thinning; or it may itself be unbalanced by a bigger limb crowding its neighbor—in that case two trees are threatened. The large limb should be pruned for the general good.

When surroundings are uniform, prune the lower limbs only, to force growth of upper limbs and to increase the size of the upper stem, or reduce the taper.

With clean-cut replanted trees, we guard against distortion from the start even back to the plants in the nursery rows, or transplanted, when they are there distorted; it costs more to care for an imperfect tree than it does for a perfect one.

While we are planning for an ideal plantation, there are many reasons why perfection can be but rarely realized. But our plans call for only 60 perfect trees out of 726; the removal of the 666 from time to time affords a fair chance for a good selection for the last crop. But for the importance of a free circulation of air among the growing trees, which follows the removal of the lower limbs by artificial means, it would not matter so much as to the other woodgoods, especially as to the value of the pulpwood.

This feature is in direct contrast to the close and sultry air incident to the thick stand and the heavy crown intended to suppress growth to help natural pruning by hastening decay of the lower limbs—a condition again controlled by the nature of the tree or its environment, with the predominance of sap wood in the branches of the cottonwood and loblolly pine, decay under such conditions occurring much sooner than with the White Pine, with its far greater percentage of heart wood, which resists much longer even under unfavorable conditions of growth.

But none of them could resist the keen cutting blades of the pruners, just a little at a time with regular cultivation to keep down the vines and other vegetation, where spacing is so moderate that the life and health giving air is provided at the start, without which real growth cannot be expected in a lifetime.

Artificial pruning of forest trees, unlike lawn, shade or fruit trees, is done to improve the quality of the wood in the tree. First, to control the form of the stem to prevent forks, crooks, crotches or cross-grained wood. Second, to permit cultivation which kills vines, noxious weeds and other vegetation and increases tree growth. Third, to admit the free circulation of air for the tree to breathe. Fourth, combined with cultivation to fireproof the planting. Fifth, to eliminate the knots, so that nothing but clear wood may be secured. Just a little should be done every year during the months of July and August when the season's growth is nearly completed; the exudations from the cut branches promptly cover the surface of the wounds and hasten healing before the beginning of another growing season.

Otherwise if done at the beginning of or before the growing season, growth is checked until healing is complete. Just as the bud begins to swell, the tree and its branches to the very tip are full of water as at no other season, ready for the leaf making process then so near at hand.

If pruned at that stage, growth is not only interrupted but the health of the tree is endangered. The time to prune depends on what the object may be. Often fruit trees make wood so fast that the crop of fruit becomes scarce; in that case, prune before the growing season.

The damage caused by a smart saying of a thoughtless, so-called expert, "prune when your knife is sharp," is beyond calculation. As well the German experts advice as to pruning the conifers.

But both seem to be in conformity with the established laws governing tree growth, but not in harmony with the teaching of the "primer on forestry" "that water is pumped up by the leaves" instead of water forced up to the leaves. Copious supplies are on hand long before a leaf starts to grow, which is fed to them as they grow by nature's plan.

The question of pruning had already been dwelt on in considerable detail, but as it is the very foundation of successful forest tree growing, we naturally revert to it in such a way as to invite discussion, that more light may be shed on the subject.

With our system, a clear stem of thirty feet in fifteen years may fairly be expected, and the extra cost of pruning high should be considered only from the standpoint of "will it pay?"

Facts and figures have already been presented to show that the first cost of artificial reproduction by the intensive system that produces such results as are herein stated are less than the system of nature that after a long time yields only knotty wood from which no profit can be expected.

We fear no ill effects from the loss of leaf growth by our annual pruning; it is so gradual that it produces no shock to the tree that might come from severe periodical pruning.

Though even that danger is greatly magnified; nature has wonderful recuperative powers, it is in fact, no easy task to kill a healthy tree.

Trees with every limb and leaf cut off last fall are mute witnesses of the fallacy, for they are now in fuller leaf than before they were so pruned, much fuller than their nearby neighbors that were not so treated.

Whole rows of them large and small show no checking in growth last year from that cause because growth had been completed before they were pruned, but they were pruned at the right time.

The idea that pruning is harmful is purely academic, excusable under the old order of things, when it mattered not one way or the other, when there was plenty of time to await nature's slow process of pruning; now retardation but faintly expresses the ill effect of the sultry air, nature's dull pruner.

We make the point that we fear no harmful effects from a limited crown, also that an excessive leaf growth is overrated. But in fact, such extreme clear bole is not practical, and the idea has invited criticism and discussion, both of which may prove helpful.

It is no part of our plan to get rid of leaves. It is the useless limbs that we are after in order to improve the quality of the wood, by "dislocation of increment," that is, to put it where it will make a better tree.

We contend that by our gradual plan of pruning at the proper time, a little at a time, of the lower and distorted limbs leaving none older than four years up to the tenth year, we do not necessarily reduce the leaf surface or growth, as their removal tends to increase both the length and size of the upper limbs, and increase their capacity to bear healthier, fresher, greener, stronger and a more vigorous crop of leaves.

That claim applies, more especially to the conifers.

We have no anxiety as to the present or future demand for all woodgoods now standing or for the new growth when ready for the market at good prices for the wood and a fair profit for handling it. The war hastened a situation that was looked for several years later, but it is here now and here to stay, especially when we consider the constant increase of city population. The greater part of their requirements for living must come to them from a distance in a package of some kind, mostly of wood or paper, as we now see it. Early as the new crop of woodgoods may come, it will not arrive too soon, for the demand that will then be with us, will surely be great and for years constantly growing.

Nature's methods so far as growing trees unaided by help of hands and brains where people live is a thing of the past as much as wooden war ships. No matter what policy or plan the nation or state may use, nothing but one that promises a quick return and a fair profit can in any way interest the average farmer, who certainly understands if it pays to plant and care for an orchard of fruit trees, it must also pay to care for the forest tree. Nothing but best methods will meet the demand or secure the aid of that vast army of farmers already trained and equipped tree planters.

It is the idle and cut-over wood land (now an eyesore) that we purpose to utilize for that purpose. To clean-cut one-tenth each year, and promptly replant it, under present conditions is a profitable business proposition for the farmer now as never before. It would have been the grossest folly even so late as ten or twenty years ago, for the very reason there was then plenty of cheap wood-goods to be had from all quarters with low freight rates, without the expense of any kind of planting. Then the inferior woods and the small timber and the so-called weed-woods had no value equal to the cost of handling, to say nothing of the cost of growing them.

CHAPTER XIV

Experience with 25,000 Acres of Loblolly Pines

ON a tract of an area of about one hundred square miles, located on a branch line of the Atlantic Coast Line Railroad, about twenty-five thousand acres were in timber (and half as many in farm lands) of all sizes and kinds, mostly pines, standing within two to six miles of a twenty mile logging railroad, one hundred and twenty miles away from the saw mill. The small and inferior wood left there ten to fifteen years ago (unless since removed) should now be worth more than the entire tract originally cost.

Then the contract cost of logging was $4.50 per thousand feet delivered on the Coast Line log cars, of which forty carloads moved to the mill every other day rain or shine. The railroad freight for the one hundred and twenty miles and the Belt Line charges were four dollars, and allowing $1.50 for stumpage brought the cost of the logs at the mill to ten dollars per M. log scale, Doyle's Rule, a cost but little less than the selling price of the lumber, because of the low grades from such small logs. (Most of which were second growth.) But for the excessive overrun, and the profit on the by-products, the saw mill, kiln drying, shipping and overhead charges could not have been met.

We mention these facts to show to what extent competition, after the panic of 1893, denuded the forests with so little for stumpage, without profit for the mill man and for years nothing for upkeep. Railroads received their freights; Insurance Companies their premiums, the State taxes and labor their wages. Building was encouraged by cheap material.

During that time floorings were laid down in London, freight, insurance and commission paid, for seven pounds, five shillings sterling per St. Petersburg standard. Equal to about thirteen dollars and fifty cents per thousand feet F. O. B. steamer *Norfolk*. Good evidence that there was then no demand for artificial reproduction of trees.

However, in those days of low cost of living, things were somewhat different. Freight charges to London, Liverpool, Antwerp and Rotterdam were fourteen and Bremen and Hamburg sixteen cents per hundred pounds, less than three dollars per thousand feet. Now the freight rate alone would absorb the entire net selling price of the shipments of those days.

Of the twenty-five thousand acres referred to, the yield for the entire tract was only an average of about four thousand feet per acre, log measure, about three quarters of which came from about one third of the trees (seven trees per acre), and one thousand feet from two thirds of the trees (more than fifteen trees per acre). Of the latter it often took forty, sixteen-foot logs to make one thousand feet, Doyle's Rule.

Had those fifteen small trees been left standing, a profit could have been made on the three thousand feet from the seven larger trees (and they were not large) but the small trees then cut at a loss, would have been ready for a later cutting with a greater yield and a better grade than the first cutting. It would have paid well if those young small trees had been pruned when first purchased, or even during the progress of the cutting.

Farmers, however, of this generation need have no fear of overproduction for all of them will not begin to plant at once. The Census of 1800 showed a total population of less than six million, in 1830 over twelve million, in 1860 over thirty-one million (more than double every thirty years). In 1870 there were over thirty-eight millions, and there was then not a city in the Union of one million people. In 1900 over ninety million people, just fifteen times as many; what may it be in the next hundred years?—fifty million increase in thirty years—and now a dozen cities are fast aspiring to that distinction. At the first Census less than 15% lived in towns and cities: their housing, feeding and warming was not such a problem for the 85% of the farmers to provide for, as it is in these days for the 45% of the farmers to provide for the 55% of the denizens of the towns as well as for themselves in both cases, with the ratio growing against the farmers constantly.

Transportation and good roads, power and machinery have made it possible, now farm produce is sent to the cities in packages of some kind mostly of wood. The nearer at home the material for packages is produced the better it will be for both producer and consumer of foodstuff, as the cost of transportation and middleman's profit has either to be deducted from the farmer or added to the consumer. Generally both have to stand it for the benefit of transportation and the middleman.

Just imagine the wants of our people twenty years hence, if the increase is even much less than half of the average of the last fifty years of the past century: more people living in the towns and cities now, than lived in the entire country only thirty years ago. Long before that time nothing worth while but second growth trees can be found this side of the Rocky Mountains. It will then be apparent to those farmers of to-day who providently began to look ahead and took action to meet the coming want that they did not begin too soon.

We have practically covered our practice at "Lotuswood" though there is still much to be told on this subject that may better be affirmed by the quotations and excerpts from the official documents that we rely on to justify our claims, radical as they may appear at first glance. We have confined our quotations strictly to the subject of "artificial reproduction" and by the "intensive system." While there is much of real interest to the student on other phases of the subject of forestry, we have no place or space for more than one division of the subject, namely, "artificial planting and care." That we have departed from the well-beaten path we acknowledge because it is plain that that path leads nowhere that farmers can follow, while we here blaze the way in the light of to-day's discoveries. If it but starts a movement of that kind the effort is well worth while. That "we know how to grow trees" is our excuse for our presumption for encroaching on others' preserves.

To tell why and how our certainty arose, would be tedious, for the story would have to go back to the latter end of the first half of the past century for our earliest recollections of our association with trees and the tree business. In the ever changing currents of trade new conditions would arise that had to be accepted and new methods and markets had to be practiced and found, and in both of these activities we have been pioneers, and we are responsible for our share of the denudation that has been going on since that time. The end then justified the means for the trees then standing "cumbered the ground," and their uses for human wants fitted into the times and helped provide for the comfort and growth of a great nation. It was plain to the student of domestic economy as well as to the thoughtful laymen, that the early destruction of the forest would result, which the great war only hastened a little.

Reproduction by artificial means by private enterprise was before that event a subject only for the state and nation, the student and the dreamer. Such a practice had no place here then. Vast forests were then being cut over to make room for more people, and to supply their wants by tillage for food, raiment, shelter and warmth.

America can have no quarrel with the past, it is the future that concerns her and her people, which will be met wisely by the bounty of nature aided by science as heretofore. The states have their timber problems, well worked out on their own lines, and many of them are making substantial progress in that direction. But so far no plan has been suggested for the practical improvement of the woodlot, that the farmer considers workable. Or one that the foresters will claim to be a profitable one for them to use.

As late as thirty years ago, with the rapid extension of railroad transportation, new forests were constantly entering the field of competition so that the supply of trees, timber and lumber was far in excess of the demand in the domestic and export markets, to meet which many oversea voyages were made to secure new ones, and new outlets for our surplus stock.

My observation, study and experience in this line of thought and effort at home and abroad in peace and in war and in intimate association with the business of trees of commercial kinds, and an active experience with these kinds during the greater part of a long lifetime, prompt me to feel that I have something timely and useful to tell.

The desire to be accurate has led to long hours of research, that has only strengthened my faith in the intensive system and modern methods, not a revelation to thinking people, but long since well understood by them.

CHAPTER XV

Ancient Forestry

TREE-PLANTING has been an occupation since the days which "the memory of man runneth not back to." Although Solomon was a man of wisdom, he too or his forefathers must have neglected tree-planting in his own country. When he decided to build his temple he sent to his neighbor Hiram 80,000 hewers of wood and 70,000 bearers of the burdens, with 3300 overseers (I Kings v, 15–16) "and they went down the river in floats, to Joppa the Cedars of Lebanon and the fir trees."

This was said to have taken place 3000 years ago, and nearly 500 years after Moses had been 40 years lost in a Wilderness (it must have been a sizable woodlot) and more than 2000 years after the first Fall of Babylon and Nineveh. How many times they may have been denuded and reforested during those ages, history does not tell.

They seem to have had a tree country that suffered from it without attention to reforestation in time to save a nation from destruction, with only the story of the stones to tell.

Later on, however, we have the unbroken record of 2000 years of Japan's tree planting, and after all those years, now with a population of 360 people to the square mile, she can furnish far-off Australia (with its less than one and a half persons to the same area) its woodgoods produced by methods of reproduction that the outside world might study to advantage.

Whatever may have been the fate of Europe from this cause during the Dark Ages, we have little to go on, until the advent of the Moors in Spain for 700 years, into whose hands the keeping and revival of letters fell. Then came the Renaissance with the old masters embellishing the walls of the palaces with art and their grounds with trees. Preceding those days by only a few hundred years, Europe and Asia must have been reforested again, or Genghis Khan, the great Tartar conqueror, could hardly have led his victorious army to the gates of Peking and back, and then west to the Oder, in anything but a wooded country.

Marco Polo tells us of the beautiful groves and gardens in "far Cathay" a hundred years later, about A.D. 1300. We also have interesting details of most extensive tree plantings of such landscape engineers as Michael Angelo, Leonardo da Vinci, Raphael, and a host of old masters of science as well as of art, as is told in the diary of John Evelyn, a famous English tree planter, a member of the Royal Society, an extensive traveler and a keen observer.

February 8, 1644: "I took coach for the famous Jardine Royale. All varieties of ground for planting and culture of Medicinal simples, having hills, meadows and wood natural and artificial. "Bois de Vincennes, a noble castle, fit for a royal court a chief prison for persons of quality. A park walled in full of deer and a grove of goodly pines."

"Through the Tuilleries a princely fabric, we returned through another gallery where hung all of the Kings and Queens and prime nobility of France. Another private garden of the Queen under arches whose terraces were paved with stones of great breadth, has a pleasant aviary, fountain and stately cypresses."

"It looks to the river, where are seen a prodigious number of barges and boats of great length, full of hay, corn, wine, and wood which this vast city daily consumes." I finished this day in the Tuilleries safely contrived for shade by groves of tall trees, in the middle being elms, the other mulberries and a labyrinth of cypresses."

(Imagine when these tall trees, especially the slow growing cypresses, must have been planted to have attained the size he describes, showing that artificial planting of forest trees was the regular practice of more than 500 years ago.) February 27, 1644: "Took horse from St. Germain's a stately country house of the King's five leagues away, rarely watered with fountains, and statues and groves. Hence to see Cardinal Richelieu's Villa a league further away. The gardens were magnificent I doubt whether Italy has anything exceeding it. The large gardens, vineyards, cornfield, meadows and groves, walks of vast length, so accurately kept and cultivated, etc."

"At Fontainebleau, fourteen leagues from the city, in the largest gallery, 360 feet long and 18 feet broad, has all of the king's palaces painted on it, great trees, etc."

The foregoing excerpts are selected only from some of those entries relating to artificial plantings of trees so long ago by a famous landscape gardener of that day.

(It would seem that we have gained even less in art than in the science of woodcraft in these several centuries judging from the familiarity with these subjects as shown by the writings of a man born more than 300 years ago.)

In my travels on the continent and in the United Kingdom, I confess that the artificial plantings in the old castle grounds attracted my attention more than the castles themselves, castles are good to read about, but trees to look at are living lessons of the beautiful, and I am free to say that what I know of forests in Europe and Africa came more out of books than by sight. So far I have failed to see or learn where European forestry ever fitted into our problems of that kind. There the system was the growth of ages and was doubtless the best for them then.

While not state-owned, to a very large extent they were strictly under state control and the practice of conservation was one of systematic management. Through the slow growth of time it suited the wants of its people and later it was coupled with the purchase of so much cheap woodgoods from the original forest of other lands.

We know the forests of France, England, Germany or Italy never yielded as much as the same area would have under a system of artificial planting with the intensive system of culture and care, but the yield was sufficient for them at that time. They have been subjected to a stress of the last few years that demands new methods.

That new conditions will force a change of system is already evident. The devastated forests will be clean-cut and replanted, and the matured forests will be gradually treated the same way, and should a war cloud again fall on that scourged region (if not too soon) they will be better prepared. To that end they may study our intensive system and even our Loblolly pines with profit.

Voluminous as the quotations from the following reports may appear they are in fact but a very meager part of them, though quite full as related to the subject of tree planting that we are dealing with. Our thesis, concisely stated, is the artificial planting and annual pruning of forest trees. A selection of varieties for a rotation that produces intermediate crops, one after the other, while the permanent forest grows, by the intensive system.

CHAPTER XVI

Official Quotations, Georgia, South Carolina and North Carolina, Virginia Shortleaf Pine, Maryland, New Jersey, Connecticut, Massachusetts, Maine

EXCERPTS and quotations from Official and other Documents, relating to artificial reproduction of trees.

GEORGIA University at Athens of Agriculture and Forestry, refers to U. S. Department of Agriculture, Bulletin No. 153, *Forests Plantings in the Eastern States*, and to No. 1123, *Growing and Planting Hardwood Seedlings in the Farm.* From these bulletins quotations will be made later.

SOUTH CAROLINA. Report of Forestry Service dated 1913, pages 6 and 7: "As the mountains are approached, Hardwoods take the place of pines."

"The valuable pine forests were the first to go and today very little of them are left."

"Exploitations of the Coastal Forest during recent years has been rapid."

While this report, like all of them, is replete with statistical and other valuable information, there is nothing to throw any light on tree growth by artificial planting, nothing whatever of intensive methods of culture, planting or pruning.

North Carolina. The last available report, Bulletin No. 23 of the State Forester, 1911, page 14:

"In 1909 North Carolina with a cut of two billion one hundred and seventy thousand feet board measure."

On "page 13" it says: "The assessment on timber land varies from $2 to $7 per acre, about half that much on land that has been cut over."

On page 17 the suggestion: "By protection from fire and by encouraging the more rapid growing and by saving the more valuable species (by thinning or removing weed-woods) the annual yield can be increased in a comparatively short time."

On page 28: "White pine except in remote places has been culled out, and will produce well in old fields and unburnt woods and in favorable situations young trees grow rapidly, often making an annual height growth of 2 feet."

On page 38 and 39: "It is estimated 30 to 40 per cent is burnt over every year—fires do not seem to damage virgin forest like young growth."

The reason the forests are burnt over so often is that live stock in that country is more profitable than lumber, pulp wood or other woodgoods, on account of the cost of transportation and hauling. It will be a long time where population is so sparse before reproduction of forest lands will be interesting to the remote holdings of the live stock raiser.

There the percentage of wood land so far exceeds the farm land and the cost of transportation both to the railroads and on the railroads, that it will be a long time before reforestation will be of interest to the farmers generally of that state.

VIRGINIA. *Report of 1912, Department of Agriculture. Page 7:* "That in 1909 the quantity of pulp wood nearly 89,000,000 feet was required, mostly spruce and poplar, purchased in terms of cords."

There is nothing in this document relating to artificial planting, or pruning, or intensive tree culture. A fine field is suggested for its adoption, as the many farms lying close to its splendid system of navigable rivers and to the great through lines of railroads to the great markets of the North, should find a better way of restocking their wooded acres than the slow and sloven process of Nature, when it is cheaper to produce a high-grade tree than a common one.

VIRGINIA, continued. *A Report of the United States Forest Service on Short Leaf Pine in Virginia, by W. W. Ashe, Esq., Forest Examiner, Forest Service, dated Richmond, 1913.*

While it is about eight years behind time, and long before the general use of all soft woods, including pines in the paper making trade, there is much information bearing on the question of reproduction.

Page 6: "The average stand of pine is far too thinly stocked, the yield, grade and value is lower than thick stands."

"Crowded areas occur in nearly all stands; crowded stands can be improved by thinning; it accelerates growth, hastens maturity, and produces a superior quality of timber."

"Stands as old as forty-five years respond to them well."

"Where natural seeding has not formed dense stands in ten years on the whole area, it can be completed by planting seed."

"Stands restocked this way can be expected to return a fair rate of interest on their cost."

"If young stands are protected, full stocking secured, and the stand subsequently thinned, the yield of saw timber from a forty-year-old stand can be more than doubled and its value greatly increased."

Even without preparation, fertilizing, pruning or cultivating, simply thinning, he admits this in the face of the fact that: "Ten years may be wasted in securing a stand," and this with short leaf pine which he differentiates from loblolly in favor of the latter.

There is nothing in this report referring to artificial pruning.

It is this waste of time that fails to attract the interested attention of the farmer. Volumes are written on the subject of how to secure a natural stand by mother trees; results could not be had, worth while, in sixty years.

Table 12 and 13, pages 30 and 31: Cost of growing short leaf pine, thinned and unthinned.

"Age of stand 35 years, unthinned $33.43, yield 1400 feet, cost of growing 1000 feet $23.80. Thinned cost $29.64, yield 13,400 board feet, cost of growing per 1000 board feet $2.21. In both cases land is reckoned at $5.00 per acre and interest and taxes at 6%." (This is from periodical thinning, not of the yearly kind.)

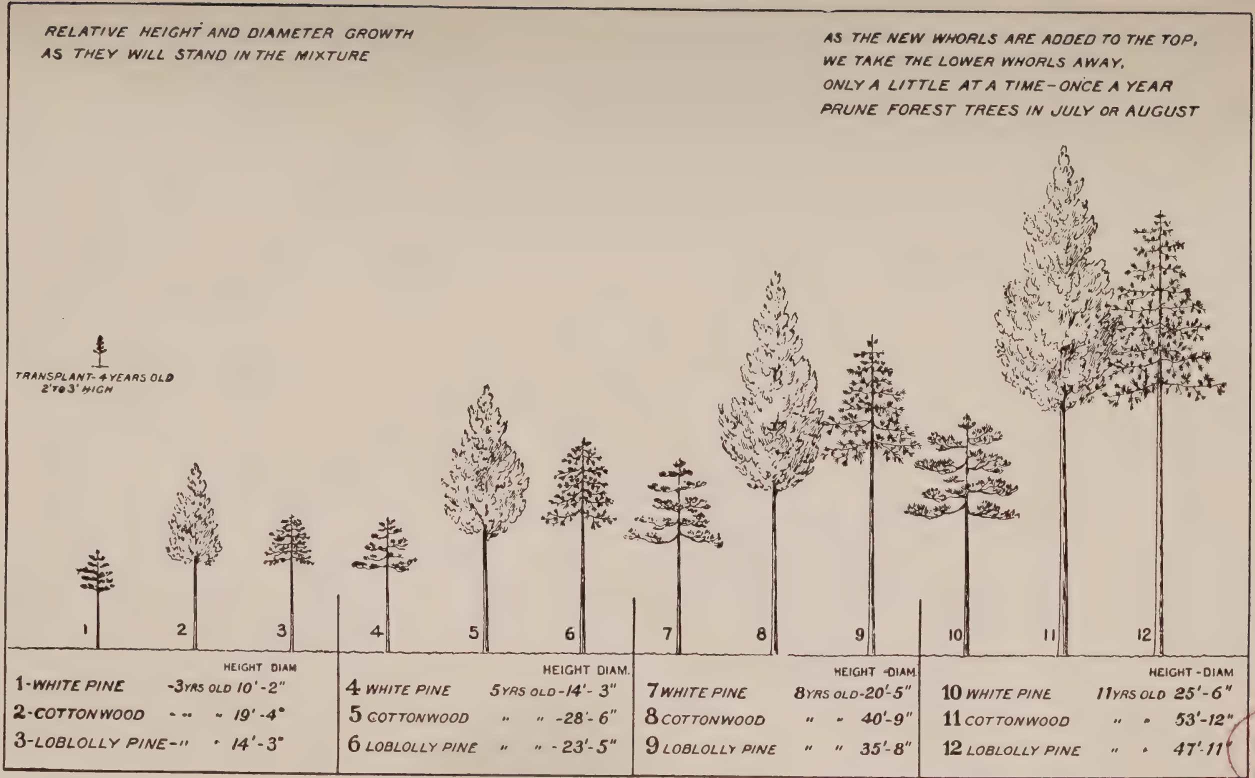
Page 31, Table 13: "At 40 years thinned stands 16,400 board feet at $2.00 per M stumpage yields $32.80. While the unthinned stand of only 6000 feet yields $12.00." (While if considered at the relative value according to quality produced by the two methods, if the unthinned and unpruned stands were worth $2.00, the pruned and thinned would be worth $6.00 per M or $98.40. But had the ground on which the trees were growing in nature, been properly prepared, spaced, planted and by cultivation the moisture conserved, the soil aerated, the weeds, grass, briars, vines and bushes (all consuming plant food and moisture) destroyed, what might that comparison have been! Then again they were tabulated when cheap wood and woodgoods were the fashion, now a dim memory.)

Were we writing a book on forestry we could find stores of information in the various reports of this author, which are readily available to the student. But we are only trying to tell what we know about planting and growing a few kinds of trees already well known to the trade.

There is by comparison much in that report indirectly bearing on the question of modern methods of reproduction of commercial forest trees, and useful tables painstakingly worked out, to prove without question that farmers cannot be induced to embark in the enterprise of trying to get something out of (next to) nothing under conditions then existing.

VIRGINIA, continued.

Page 8: "Trees of clear boles should command a stumpage price of $10.00 per thousand feet" (at a time when average stumpage was worth less than, $3.00, about three


RELATIVE HEIGHT AND DIAMETER GROWTH
AS THEY WILL STAND IN THE MIXTURE
AS THE NEW WHORLS ARE ADDED TO THE TOP,
WE TAKE THE LOWER WHORLS AWAY,
ONLY A LITTLE AT A TIME–ONCE A YEAR
PRUNE FOREST TREES IN JULY OR AUGUST
TRANSPLANT-4 YEARS OLD
2' TO 3' HIGH
1
2
3
4
5
6
7
8
9
10
11
12
HEIGHT DIAM
1-WHITE PINE -3YRS OLD 10'-2"
2-COTTONWOOD " " " 19'-4"
3-LOBLOLLY PINE-" " 14'-3"
HEIGHT DIAM.
4 WHITE PINE 5YRS OLD-14'- 3"
5 COTTONWOOD " " -28'- 6"
6 LOBLOLLY PINE " " -23'-5"
HEIGHT -DIAM.
7 WHITE PINE 8YRS OLD-20'-5"
8 COTTONWOOD " " 40'-9"
9 LOBLOLLY PINE " " 35'-8"
HEIGHT -DIAM
10 WHITE PINE 11YRS OLD 25'-6"
11 COTTONWOOD " " 53'-12"
12 LOBLOLLY PINE " " 47'-11"

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times as much as the second growth unpruned or the knotty kind.)

"In a natural twenty-year-old stand the number of trees should exceed 1500 to the acre; at 40 years it has decreased to about 750; at 60 years to less than 450."

On page 16: "The elimination of weaker specimens by natural process takes place too slowly because the growth of the trees that ultimately survive is retarded by the struggle for light and food. Yet limited crowding is necessary. Long, straight stems reasonably free from limbs by judicious periodical thinning it is possible both to favor competition and to relieve overcrowding and greatly accelerate growth. Such thinnings reduce the number of trees, but produce trees of larger diameter, clean stems and with little taper."

On page 20, Table 1: "At 20 years, unthinned stands have 600 trees under 4″, 600 trees 4″ and 400 trees 5″."

"At 30 years there are only 7 trees of 9 inches in diameter."

On page 18: "At 20 years old under average conditions wood that could be cut would average from 2″ to 4″ in diameter."

We have dwelt on these facts from an official document to show the futility of trying to induce a sensible farmer to give his time and attention to a system which admits that the only reason for thick stands is natural pruning, a process which takes from 25 to 45 years to shed their lower limbs, before clear timber can begin to grow.

It is admitted that clear lumber is worth two to three times as much as the unpruned or knotty lumber, but not a word is said about artificial pruning, when clear timber begins to make after the first year. The useless 1000 trees more or less need not be planted to sap the plant food, moisture, light, air and warmth from the 720 trees that we plant in order that all are to be reaped for a useful purpose, and not for useless thinnings, that can average only 2 to 4 inches in 20 years.

Neither is there a word said about proper preparation, careful selection of sturdy 2 to 4 year old transplants, and planting, inoculating, fertilizing, liming, cultivation, artificial pruning and thinning (or cutting) for a marketable product. The article admits that periodical thinning alone will double the crop.

We would not be interested in any inferior species of pine, so long as both loblolly and white pine plants or transplants are obtainable and ready made.

Loblolly or North Carolina Pine. By W. W. Ashe, Forest Inspector, U. S. Forest Service, Prepared in cooperation with Forest Service, United States Department of Agriculture, 1915.

Page 1: "The short leaf (loblolly) or North Carolina pine grows under many diverse conditions which affect its form, size and character of wood, and is in consequence known by many names. The name loblolly is used throughout the body of this report."

Page 3: "Loblolly pine, short leaf pine (of the coast) and North Carolina pine (*pinus tæda*), bark on large trees generally more than an inch thick at the stump, bright red brown, broken into large oblong plates, branches ascending except on large trees, leaves in 3's three to seven inches long. Cones three to six inches long, grows nearly everywhere except on the wettest sandy peaty soils and on sand hills." (As already described elsewhere, the loblolly of our practice can be identified by the length of the leaves or needles, rarely less than six or seven inches with three in each cluster.) (I am authorized by the author to correct his statement as to the length of the needles.)

Page 4: "Loblolly pine is the most important timber tree, from Delaware to Texas one hundred miles from the coast. It is conservative to say one and a quarter billion board feet were cut in North Carolina in 1912 of loblolly pine timber."

Page 7: "The amount of matured loblolly pine timber in North Carolina is about fifteen billion board feet."

"The cut of North Carolina pine lumber has probably reached its maximum."

"The coastal plain region of North Carolina extends inland from the coast for a distance of one hundred to one hundred and fifty miles (10 to 50 feet above sea level), becoming more elevated on its Western border. Many of the best loblolly pine soils require artificial drainage before they can be profitably farmed."

Page 14: "The great number of forest types in which loblolly pine occur is noteworthy as showing the virility and aggressiveness of this species."

Page 20: "The age of the pine seldom exceeds 200 years, the height of mature trees ranges from 115 to 130 feet, and the diameter from 24 to 30 inches. It is believed by thinning, 900 to 1000 board feet per acre per year can be obtained, including the thinnings." (By ordinary methods.)

"In a stand near Leechville, North Carolina, the average age of one hundred years, the height of the dominant trees is from 110 to 120 feet. The stand consists of 120 merchantable trees per acre and will yield about 30,000 feet board measure."

Page 24: "The rate of growth of pines is rapid, for several years exceeding four feet a year in height. The wood is soft and even-grained,—resembles the so-called rosemary or forest pine."

Page 26: "Stems of young trees continue through a crown without dividing. As a rule the stems of young trees are nearly straight."

Page 39: "The loblolly pine is not exacting as to soil. It grows naturally on many soils."

Page 41: "On poorly drained soils it is capable of establishing itself, but the growth is slow. On the thoroughly drained rolling oak uplands, usually with clay soils, but sometimes with shallow or coarse gravelly soils, young pine growth is becoming common whenever the hardwoods have been cut."

"The loblolly pine requires a full amount of direct sunlight for its best development during the younger stages of growth. It will bear overshadowing for several decades and still be able to make vigorous growth on the removal of the shade."

Page 43: "The most crowded trees in the intermediate crown class die rapidly after their thirty-fifth year. This makes thinning desirable. Young trees on best sites will grow healthily till the high pole stage and on the removal of the shade make rapid response to the increased light."

Page 44: "Loblolly pine reproduces itself prolifically. Its ability to establish itself under adverse circumstances, is aided by the early rapid development of its root system. No other species can successfully compete with it on three fourths of the coastal plain. Neglected by both cattle and hogs."

Page 49: "The leaders of loblolly pine are sometimes broken by sleet or wet snow."

"Stands of loblolly pine are particularly liable to suffer from windfall after heavy thinning or culling." (Tow good reasons for the uniform annual pruning and later the annual cropping.)

Page 54: "Growth of the best young stand 29 years old in Pitt County; the board measure value 37,277 feet; there were 320 trees to the acre."

Page 58: "Loblolly pine attains an average height of only two feet during the first two or four years. After that it begins to grow rapidly."

Page 59: "First quality loblolly pine, dominant trees at twenty years, fifty-six feet tall; at thirty years, seventy-five feet; at forty years, eighty-nine feet; at fifty years, ninety-nine feet."

Page 60: "Dominant trees make their best growth between seven and fifteen years, often as much as four feet a year for several years, during the second decade averaging three feet a year."

Page 62: *Table 15.* "Trees of first quality when five inches in diameter breast high show 45 feet tall; at 7″ diameter 60 feet tall; at 10 inches, 79 feet; at 12 inches, 89 feet; at 15 inches, 101 feet; at 20 inches diameter, 115 feet tall (9′ for early and 6′ for later growth per inch in diameter)." (Artificial plantings with intense methods increase the diameter growth faster than the height growth.)

Page 64: *Table 16.* "At 40 years. T.S. 13.2. O.S. 16.09.

"At 50 years. Thick Stand 15.7. Open Stand 19.02."

One 19″ tree contains more board feet than two 15″ trees.

Page 69: *Table 21.* Shows the difference between the growth of the crowded stands and the open stands of dominant trees of first quality in board feet based on actual cut $\frac{1}{7}$ inch saw Kerf Mill Count.

25	years.	Thick	stand	55	feet	B.M.	Open	stand	104	feet
30	“	“	“	89	“	“	“	“	159	“
40	“	“	“	166	“	“	“	“	296	“
50	“	“	“	275	“	“	“	“	436	“

(Open stands without regular pruning produces a knotty tree.)

These tables show beyond a doubt the uselessness of the thick stand—an increase of 70 per cent, as compiled by actual count from trees grown naturally, without any artificial aid whatever.

We are not at this time interested in anything that will not yield a prompt return for the labor, land and money invested. We are not carrying our investigation beyond the completion of the rotation of the first fifty years of growth, which we hold we can accomplish with our intensive method of artificial planting and pruning in that time. What the report shows will take more than twice that time to accomplish with a low grade of lumber in the end.

But the point we rely on in making the proposition appeal to the farmer is the prospect of making a better tree and an early regular annual profitable crop, with an ultimate forest of prime trees of great size and high grade by the intensive system, and on our clear-cut replanted lands, pruned and cultivated, thereby fireproofed.

We have dwelt on the report of this authority on everything relating to certain kinds of forest trees in order to justify our selection of loblolly pines for our own planting, and for our recommendations of its general use in mixture in a much wider field than the coastal plain.

The material for this report was gathered between the years 1895 and 1913 and in the light of that time it seems to have fully covered every phase of the subject.

On page 134: "So long as there was an unlimited supply of virgin forest the protection of young or old timber and the close investigation of the forest was not essential. Approximately three fourths of the loblolly pine cut is from cut over land and is either the product of the young trees or of the small trees left at previous cutting; there is need for a change in the methods of handling the forest."

MARYLAND REPORT. The report of the Chief Forester of Maryland of 1918 and 1919 gives much interesting information about loblolly pine, and the first obtainable account of valuable experiments with its artificial planting and resultant growths.

On page 30: "The yield data showed such an amazing growth for loblolly pine that it seemed advisable to gather more data concerning methods."

WHITE PINE. *Page 31:* "No evidence of disease was found in 1917, and subsequent inspection strengthened the belief that Blister Rust has not reached Maryland. Stringent quarantine against white pine grown out of the state is maintained, so there is no reason to believe that this disease may not be kept out altogether. Steps have been taken to combat the White Pine weavil."

Page 32: "In 1900 the Forest Service of the United States Department of Agriculture established plats of loblolly pine at Berlin and Coulbourn and another near Sinepuxtent on the Eastern Shore. They have been turned over to this State Board of Forestry. Measurements have been made at intervals of five years. The last one due in the summer of 1920 will soon be available for public information."

Page 33: "As far back as 1908 experiments in broadcast seeding were undertaken in co-operation with the United States Forest Service. First to determine if loblolly pine of the Coastal Plain, could be successfully grown in the upper Coastal Plain section, as a substitute for scrub pine, a much inferior tree. Second, to determine the best method of seeding to secure a satisfactory stand. In the first plat loblolly pine seed was sown broadcast on the grass and briars at the rate of five pounds to the acre, and left without cover or any subsequent treatment. The result was a total failure."

"On the second plat the ground was gone over rather carefully with a spike tooth harrow, at the rate of five pounds per acre. It was found that the pine seedlings were generally distributed over the plat about fifty per cent of a normal stocking for the first year but not evenly distributed."

"On the third plat the ground was prepared by one careful harrowing, the seed sown broadcast at the rate of five pounds per acre and covered by dragging the sown plat. The result at the end of the summer was satisfactory, rather evenly distributed averaging about two trees to every three square feet."

"On the fourth plat with preparation not so complete a fair stand was produced but the mice had apparently destroyed a large portion of the seed.

"The trees remained two years, the field was then plowed for a farm crop. The experiment demonstrated that loblolly pine would grow in that locality, on a higher elevation than its natural habitat."

"And by proper preparation, so as to expose the mineral soil, pine could be established by broadcast seeding. And by better preparation of the soil it is probable that 2½ pounds per acre would be sufficient."

"The seed at $2.25 per pound and five pounds per acre, made the cost expensive."

Page 35: "In the Spring of 1910 some 4500 two year old seedlings were transplanted in nursery rows where they were kept until 1911 and then transplanted to a permanent location at 'Bowie.' Due to the fact that the seedlings were hastily pulled while frost was still in the ground, they were in poor shape when transplanted to the nursery rows, and there were only 1500 transplants fit for planting the next year."

"The site selected for planting was covered with a sparse growth of grass and weeds. The transplants then averaged 12 inches high. Half were planted in a pure stand 6 x 6 feet, the remaining half in alternate rows with scrub pine stock of about the same size, and space, altogether about two acres. After two years there remained 1000 trees to the acre. The trees made a remarkable growth having kept well ahead of the weeds and briars."

"In September, 1919 (eight years later), the average height of the tree was twenty-five feet and an average diameter breast high of four and six tenths inches."

"The maximum of the loblolly pine was 30 feet in height and six and a quarter inches in diameter. While the maximum height of the scrub pine was 24 feet, and diameter three and three tenths inches. Thus showing the great superiority of the loblolly pine over the scrub pine."

Showing a most remarkable growth, notwithstanding the struggle of this plantation with the weeds and briars, the lack of fertilizer to give the plant a good start, and of the cultivation to conserve and control the moisture, aerate the soil and to keep down the sprouts, weeds and briars, etc., without artificial pruning. If counted after the tree becomes 4½ feet high, the annual diameter growth on the maximum tree exceeded one inch per year and nearly four feet in height annually.

"Figure 2, plate IV, page 28," from a photo, shows evidence that complete pruning is a long way off, and the fallen and falling dead branches and leaves insure ample fuel for the flames, which alone would make any prudent farmer hesitate to take the risk.

Even a layman would not dispute our claim that our Carolina poplars and our pines will be ready for pulp, crates and lath wood harvest within the ten years, if intensive methods are used.

The anxiety of this forester to hasten the spread of the crown, in order to completely shade the ground, and thus suppress the weeds, briars, sprouts and so-called weed-woods, is shared by the profession generally.

We on the other hand, strive to retard the shade as long as possible to let the sunshine, the heat and air in, as of vastly more importance in stimulating growth than the few leaves they may shed, to make a mulch, for the suppression of weeds, briars, etc. Our modern methods of tillage accomplish that purpose cheaper, more effectually and at once, and at the same time better controls and conserves moisture, aerates and gets down to the mineral soil, and helps to make active and available the latent elements of plant food already there.

By our annual pruning process, we not only make room for the team for cultivation, but we retard the shade, circulate the air, hold the sunlight and warmth on the ground longer. Thus permitting wider spacing we relieve the soil of the extra duty of producing something of no value, which is not only wasted but the greatest menace to a young plantation, for without those dead, dry limbs and leaves there is nothing to burn. So with this new woodlot fire-proofed, that bugaboo is entirely eliminated, and we proceed without dread of fire.

We are not primarily proposing to raise a forest of timber trees, but a plantation of trees from which a crop of woodgoods is to be harvested every year for the money from each acre after the tenth year. During the ten years between planting and harvest, we are clean-cutting and harvesting the crop of trees now standing, when the crop from the new plantation will be ready and waiting.

At the end of the twenty-fifth year from time of planting all of the poplar and some of the pines will have been harvested, and at the end of forty years from that date only sixty of the best trees will then be left standing except the hardwoods of the permanent forest.

All trees are not expected to escape damage, disease, defects or deformity. Such will be removed as they appear and even the dead trees of proper size will find a ready market. The special object of cutting or thinning, outside of their commercial use, is for the relief of the remaining trees, so that each cutting should leave a greater crop the following year, than if the cutting had not been made.

It is self-evident, when the matter is considered from a practical point of view, that there is no more reason that spacing should be beyond the capacity of the soil to grow and continue to grow trees than any other crop. The intensive system and persistent pruning obviates the so-called necessity of thick stands, so detrimental to growth and quality.

On the question of growth, Professor Pinchot in his *Primer of Forestry*, part 1st, "The Forest," on page 31 says: "The chief reason why trees stop growing in height, is because they are not able to keep the upper part of their crowns properly supplied with water beyond a certain distance above the ground. . . ." "The power of the pumping machinery more than anything else determines the height of the tree."

Whether that power is increased or diminished by an excess of leaves he does not say. The question with us is immaterial whether the growth goes to the sap from the water direct or from the water to the leaves and from the leaves back to the wood, or if a part of the mineral elements of plant food in the soil and that part conveyed to the soil from the air by the fall of water and by aeration gives to the leaves that part required to sustain life and that part to mature seed, and the other parts to the cells of the sap wood or in the several layers of inner bark, all are scientific questions that we are quite willing to leave to the scientists. But the question as to the minimum quantity of leaves that are required to promote growth is quite another thing. If only a limited supply of moisture is available which must pass through the leaves, is it not reasonable that the more leaves there are the more water will be required?

Others contend that tree growth comes from the plant food from the air through the leaves. Our guess is that growth comes from both ways through the leaves and roots. Some people are tall and some are short, often in the same family.

Page 14: "Many theories have been proposed to account for the rise of water in the big trees of California, over 300 feet above ground and it must be admitted that we do not yet know."

These remarks from such an authority are here quoted to throw light on the question of the limit of leaves when growing only forest trees (for volume and value, but not for seed) that we may prune to the limit in order to secure the maximum of clear stem and good form, by annual artificial pruning of the only kind of limbs that can be there for the first ten years, during which time no limb is more than four years old, which must necessarily be much less than an inch in diameter.

On the subject of clear growth, on page 29 he says: "But in the forest not only are the side branches continually dying for want of light, but the tree rids itself of them after they are dead and so frees the trunk from them entirely. When a branch dies the annual layer of new wood is no longer deposited on it. Then it is broken off; after a while little or no exterior trace of it remains." "Knots such as are found in boards are the marks left in the trunk by branches which have disappeared."

The latter quotation is made to meet the question raised by the Forestry Service " that we must show a clear stem can be secured by pruning the small limbs alone," a point so well known to the layman that it should have no place here or there.

While the Department officials say—"some of my views are new," not all of them are in conformity with the established laws governing tree growth; the only one specially referred to was "the question of pruning the small limbs and the inference that a clear stem would not be produced by that system."

As elsewhere stated we are not interested in "established laws governing tree growth" but we are as to how to grow them, especially how to grow them free from knots. To that end we are vitally interested in the annual pruning of the small limbs for the first ten years (at least) of their growth, during which time there can be none but small ones, which not only insures "the clear stem" but it makes cultivation possible so that we get by our new system not only high quality but increased quantity at the same time, provided the woodlot has been properly drained, soil prepared both surface and in holes and limed, inoculated and fertilized, with the rotation in the crop by the varieties selected, that is cottonwood, loblolly, and Scotch white pine.

And we get these results by open spacing, so as not to overtax the soil in the game of "the survival of the fittest" as by the old method.

Seedlings of one or two years old are in large stock in the nurseries of most of the Eastern and Middle States, are to be had at prime cost to the planter, for citizens of their respective states. These should be secured in good season and transplanted to home nursery rows, and remain there under the best methods of tillage for two years to make sturdy transplants.

In this manner good stock would always be on hand in season for prompt transplanting to their permanent locations with the least exposure. Until such home supplies will be ready transplants will also be purchased of the state nurseries at about $6.00 per thousand, while the seedlings replanted should cost one half as much, plus the extra cost of transplanting them into the home nursery rows, an operation of the ordinary farm help. By this method the roots of the young trees are not unduly exposed. All of these things count in the intensive system.

The clean-cutting plan and replanting is the only sensible one for farmers to consider, because it pays its own way from the sales of woodgoods and weed-woods from the same woodlot. The other plan may be all right for the nation, the State and the rich, also for the student of forestry and also of course in the treeless regions and for reasons mentioned elsewhere.

It is a much bigger task to properly prepare the holes for planting 1200 or 2800 trees than for 726. The difference in the cost of that item and the extra number of trees will overcome the cost of proper preparation of the ground and the cultivation of the crop thereafter. In the work of preparing for a crop to last 50 years the question of economy as to first cost should have no place, but when the most careful preparation and proper methods are less expensive in first cost, and the crop begins earlier, and is continuous, such false economy has no place whatever with a thinking farmer.

While white pine and loblolly pine are our dominant trees, for quicker returns and early cutting we will rely on Carolina poplars.

Reverting to page 36 of the Maryland Report: "Because of the dense growth of weeds and briars, a closer spacing, probably 5′ x 5′ (1742 trees to the acre), would be advisable. The examination of the 1915 plantation showed even more remarkable results than the one already so fully described."

Page 37: "The studies of the loblolly pine and the planting experiments proved the high value of the species for forest planting. In consequence large quantities of loblolly pine seedlings are being grown at the State Forest Nursery from seed collected in Maryland."

These experiments prove not only the value of Loblolly pines and White pines, for reasons already explained, value of preparation, the expense of artificial seeding; but it also proves that our statement as to growth is well within bounds, and fully satisfies as to our practice and preaching.

We lay no special claim to but hold in the greatest respect both the scientific or technical side of this important question, but we feel fully equipped to discuss the art of practical tree management for the benefit of the farmer, the owner of woodland and the lumberman.

The New Jersey Report on Forest Planting, through the Forest Park Reservation Commission, dated 1913, lays little stress on forest planting, because the State's wood-

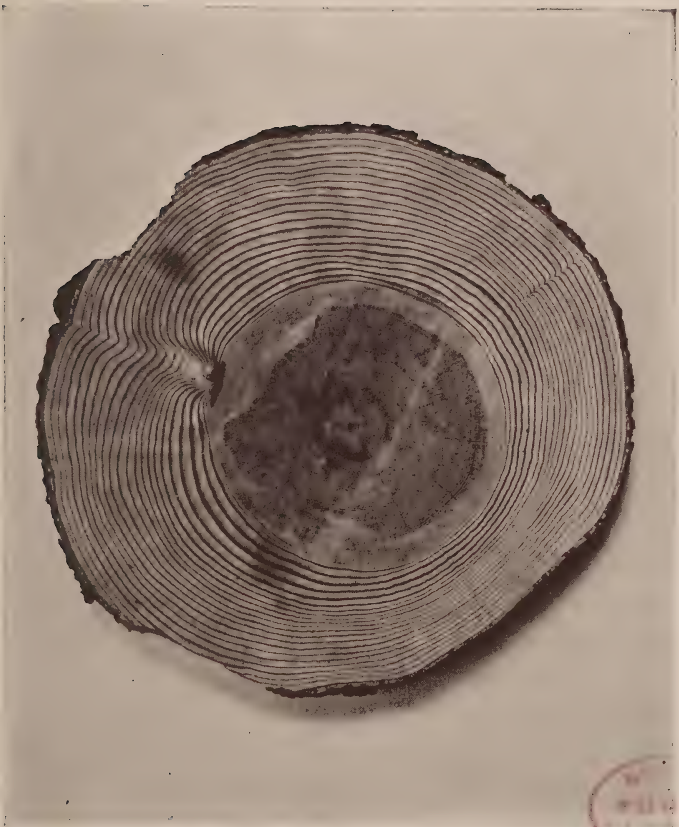


Photo by Courtesy U. S. Forest Service

Wood section of Lodgepole Pine. Note the growth of these rings during the process of natural thinning.

land area is now as great as it should be, and because it is easier and cheaper by the natural process.

"The results will rarely be as good as from a planted forest." "Many foresters recommend mixed plantings (two or more species) on the ground that one species helps another, that insects and diseases do less harm than in pure stands."

Page 9: "Pine of some sort is the world's most valuable wood." "Pine is best for planting in both south and north Jersey."

Page 10: "White pine is the most promising tree for forest planting. Large timber production at comparatively early age; a yield of 30 M feet in 50 years is not excessive; 600 feet annually per acre."

Page 11: "Loblolly pine, a native of the Southern states, where it grows with marvelous rapidity, recent experiments indicate can be grown successfully in South Jersey." "Cottonwood, or so-called Carolina poplar, a tree of very rapid growth on moist soil, should be planted not less than ten feet apart. A yield of 25,000 feet in 30 years may be expected (833 feet per acre per year.)"

Page 15: "Does not recommend either broadcast seeding nor planting seed on the spot where it is to grow. Better buy small nursery trees. The practice is to omit everything like cost, but when planted in worked and fertilized soil trees grow better." "Transplants are preferred because they are stronger and better rooted than seedlings, unless the cost is too great."

Page 22: "Cultivate tree nursery like a garden; after the second year, leave all to grow another season, and continue cultivation."

Page 23: "It is good practice to plant strong trees if ground is weedy." "Purpose of a nursery is to produce trees that are healthy and vigorous, that can be safely transplanted in their permanent places and give quick results. This is attained by constant care and thorough cultivation." "Cost of planting four year transplants 6 x 6 feet square, 1210 trees to the acre (pines) bought nursery trees at $17.10 per acre. Small two year seedling pines can be had for $3.00 per M, to be cultivated one or two years in a nursery."

Page 25: "Forestry has no place on land that is valuable for something else." "Forestry is utterly impracticable where there are forest fires." (There is but little in the report to throw any light on the subject of artificial planting, and nothing on artificial pruning. But as the report on planting was dated 1913, it was written in ignorance of present day conditions. To-day there is a market for even the so-called weed-woods, whereas then there was practically no market worth while for anything but matured timber trees. Yet there is plenty of evidence here that rapid growth can be attained by intensive methods.)

Very much is said academically of natural seeding, very little which could interest the farmer in the least, as a practical proposition. In fact in every case they admit it is too slow and uncertain to be considered, while all agree that artificial tree planting, and not artificial sowing of the seed, is the only practical way for the farmers.

The report of the State Forester of Connecticut for 1912. The first five pages are devoted to forest fires. "The first state forester was appointed in 1901. Out of the first appropriation in 1909, 1512 acres were purchased at $2.10 per acre." The first planting of 15 acres of pines in 1912 are noted. "On two separate state forests, 55 acres of white pine and 25 acres of Scotch pines, and a few acres of red pine and Japanese pines were planted." These mostly on cut-over lands, clear cut before planting, and all artificially planted 6 x 6.

On page 469: "Its replacement with a plantation of rapid growing conifers such as white pine or Scotch pine, would promise much greater returns than could be secured from natural regeneration." "The value of the product, and the shorter period necessary to produce it, would render the investment involved worth while."

The experimental station of that state is conducting a very careful and instructive experiment in forest plantings at Rainbow Station, a few miles away from the state capital, in 70 plots, varying in size from a half to five acres each of all useful kinds for such plantings at all spacings from 4′ x 4′ to 6′ x 6′, and under many methods and conditions, reference to which later will be made in the next report of 1916, of that state.

Page 485: "It is estimated in 1912, private plantings totaled 4000 acres, and in response to inquiry of the State Forest Service 59% answered."

Page 500: "The cost of two year conifer seedlings, $2.50 to $3.50 per M. Three year transplants $4.50 to $6.00."

Page 506: "Cleanings should be made in stands from three to ten years old, the first should take place in two or three years after planting."

Page 507: "Direct sowing seed has been practiced to an extent on unprepared and prepared ground at the rate of four or five pounds of seed per acre. Results are very uncertain, the cost of seed and labor equalling the cost of planting."

Page 388: "Although there were at least 53 species, within the Town of Redding, only ten are of commercial value. So that the remainder may be compared with the weeds of the farm."

White pine, Scotch pines and red pines are given first place in the State's plantings. The description of the field work in planting indicates that they have a long way to go before being classed as intensive growers.

Page 419: "White pine is a native of Connecticut, and one of the most valuable timber trees in the United States. It is easily managed and of rapid growth, especially for the first fifty to seventy-five years. Three year transplants should be used under most conditions. The conditions and growths of such plantations show that white pine completes its financial rotation in about 45 to 50 years. That is, if carried too long, the investment will consume the profits. It will be safe to say that the average should be 35,000 feet board measure per acre for a rotation of 50 years."

Page 418: "Planting is very simple, a mattock or grub hoe is the only tool required for the work. The average farm laborer can easily set out 500 to 800 trees per day." "Usual spacing 6′ x 6′. The total cost should not be greater than ten to twenty dollars per acre. " "Where transplants are used, the average plantation should have at the end of the first year 90% living."

Reference is here made to its insect enemy and fungus diseases, and prescribing the same remedies as heretofore mentioned: "mixing white pine and red and Scotch pines is recommended, because of the freedom of disease, quick growing, and useful character of their lumber. Of the red pines, three year transplants and of the Scotch pines two year seedlings are the best for planting."

The State plantation under consideration offers poor encouragement to a farmer to engage in commercial forestry as is now practiced in that State. If intensive culture and handling is impracticable, tree culture for profit is a long way off for the farmer.

MASSACHUSETTS. "Our returning soldiers in France saw the great economic importance of her forest to the Allies and their aid in helping to win the war, and although staggering under a load of debt England has already set aside millions of dollars for reforestation and other forestry work." "Five newly acquired State forests demand considerable attention." "Reforestration to the extent of 1000 acres in which over 800,000 transplants were set out, and over 700,000 seedlings were transplanted to the state's nurseries for future use, and nearly half a million small trees were sold to private planters, and a large number given to state institutions free of charge." "A very extensive equipment for fighting fire has been provided including 37 lookout towers, 30 of which are steel, the number of fire fighters now reach 1800 forest wardens and their deputies. The fire loss has been less than $100,000." See page 8.

Page 16: "Extensive as the State nursery work now is, the demand for white pine exceeded the supply."

Page 20: "The stock was sold at $8.00 per thousand."

Much space is given to the financial statement which now assumes large proportion, with little or no information as to "tree growth," but a supplementary report by the State Forester on reforestration is submitted which treats in considerable detail the question of selection, planting and care. The same coniferous trees as are adopted for planting in Connecticut and New Jersey predominate in this State.

Page 4: "The present system provides for planting more trees than is ultimately required for thinning both natural and artificial. About twenty years being required to complete the natural process of thinning."

Page 12: "Three or four years old transplants may be used in grass and brush lands when seeds would not have one chance in a thousand."

Page 9: "A bed of 4′ x 12′ takes approximately ¾ of a pound of seed, and produces from 5000 to 15,000 seedlings; the seed may be planted in the beds in April, May, or June." "They germinate in about three weeks, the seedlings are left in their original beds two years, then transplanted into longer beds spaced about 2″ apart, and remain there two years, and are called 4 year old transplants, and make the ideal tree for reforestration."

Page 10: More care in preparing the holes than in the method of the adjoining state but the same cheap idea of first cost prevails. "Two men should plant 800 to 1000 trees spaced 6′ x 6′ a day." "Mixed plantings are recommended as helpful in preventing disease."

Page 17: "The price charged for these trees was $7.00 per thousand, representing the actual cost of raising them at our nursery."

Here we have quoted freely from these reports, such general information relating to the activities of the State. However, so much of the plantings so far in New England are turned out, cleared or run down orchard and farm lands, when cultivation would be so much more effective in keeping down weed and sprout growth, and when artificial pruning, taking in the very early growth, is so much more economical, that so far the object lesson from that source is of small value in our case.

In the report of 1917—of 174 pages—less than 20 is devoted to tree culture, more than half of it is in describing a very elaborate system of fire fighting, the balance to the financial statement and laws governing that interest.

Page 43: "There are 33 active chief wardens who give their entire time during the Summer to the work of fire protection."

"The expense of which in the Maine Forestry District was for 1917, $77,627." "There is full cooperation between the State and Federal government under the operation of the Weeks law."

Page 22: "It is estimated that the present area of forest land in Maine is about fifteen million acres, of which about 15% is of that type of land called woodlots." "There are thirty-one holdings of 100,000 acres and more, two of a half million and one of one million acres." "Not counting the hard wood most of which is unmerchantable."

Page 23: "My estimate of merchantable timber 6″ and over to be thirty-five billion feet." "The average annual cut during the last ten years is about one billion feet. The probable annual growth is not one tenth of that amount." "Insects are responsible for a certain small loss of timber each year." "The natural result of harvesting annually ten times as much as we grow will end in timber exhaustion."

Page 25: "Forestry is the growing of trees not in the haphazard fashion, trusting to luck and nature for a timber crop, but with the aid of human interference and intelligence, in other words, tree farming." "The owner of a woodlot can practice forestry by selective cutting for the purpose of thinning, the mature trees, the defective and less valuable timber, providing in their places trees of quicker growth and more valuable species; removing the slash and reducing the fire risk." "While the owners of the larger and more remote timber tracts, the real wild lands, can hardly put in practice all the tenets of scientific forestry, it is possible for them to make marked improvement on their present methods."

Page 26: "It is said the expense of piling and burning brush varies from 15 to 75 cents per thousand feet of lumber cut; the complete disposal of it is generally practiced in our national forests, and is required by law in at least one state." "It is also claimed when lopping is required the logs run further into the top, thus a saving of lumber is effected."

Page 28: "Our old growth of pine has practically all been cut, for our future supply of soft woods we must rely on what we can grow on our cut over lands." "The soil of our cut over lands is the best for growing trees." "Maine is the leading state in the Union in the consumption of pulp wood, using about a million and a quarter cords a year." "If we might visualize the thousand acres of soft woods each year we might realize how rapidly our timber supplies are disappearing." "Clean cuttings has come to be the general practice. The pulp mills will take logs that hardly average 40 to the thousand feet, and saw mills will not refuse timber that is hardly more than poles, out of which they can saw but little more than a couple of laths between the slabs."

Page 31: "Public ownership, Federal and State, of cut over and neglected lands is to be desired, and will in a great measure help to insure a future supply." "Such methods could be put in practice that would not be practical for private owners to follow." "Federal ownership in Maine includes 29,000 acres, mostly cut over lands, as a part of the White Mountain National Forest." "Private ownership must generally concern itself with immediate returns. Interest charges and heavy taxes tend to force early cutting, while public ownership can postpone harvest to the opportune time."

Page 37: "If planting timber trees were more generally practiced, the matter of the future supply of timber would not be so serious, but it is seldom that we can interest a land owner in tree planting, as the harvest seems too remote to warrant so much trouble and expense."

Page 38: "On account of its rapid growth and its value as lumber, our native white pine has been in most demand for planting, but as a precaution against the blister rust alternate rows of red pine are suggested." "Young stock for planting in the state are furnished at cost, three year old transplants are recommended, price per M, for white pine $5.00, red pine seedlings 3 years old $7.50, white pine seedlings $3.50, Scotch and Austrian pines $7.50 for three year old seedlings."

The 1916–1917 Report of Pennsylvania on Forestry, and a supplemental booklet dated 1919, show the rapid strides that State is taking to rehabilitate her waste and cut over lands. On the cover page is an illustration of barren land worth in 1910, $1.00 per acre and another of the same land in 1921, with a prosperous crop of pines worth $30.00 per acre.

Page 3: "Almost 50 million trees have been planted since 1899." If planted 6 x 6, they cover about one-ninth of one per cent of its area."

Photographs of extensive nurseries with list of trees furnished free of cost. With a detailed statement of trees furnished private planters since 1910 of over eleven million.

Page 11 of the 1917 report: "Additions to the State forests include 8,135 acres for 1916 and 5,593 acres for 1917. The total corrected area to January 1st, 1918, is over one million acres."

Pennsylvania's reforestration problem is one of great magnitude with so much waste and cut over lands subject to fires, erosion and other means of deterioration; the question with her is to replant as fast as possible, looking at it now rather as a public question.

While the report bristles with details, there is nothing as to artificial pruning or thinning. The selection of trees is in accord with our practice to a certain extent. There is nothing in this report except the plates illustrating tree growth, that would encourage a farmer with a woodlot to follow the practice there. Yet from her point of view, looking to the future good of the state, its public policy is sound, and will be fully justified in the end.

CHAPTER XVII

Excerpts from "The Principles of Handling Forest Woodlands"

By Henry Solon Graves, *Forester, United States Department of Agriculture.* 1914

"The Federal Government has set aside 190 million acres on which all work is conducted on the principles of forestry." "Many land owners are seeking information regarding forestry with a view of practicing it if found to be practicable." "The literature on it as applied to this country is very meager. Much of it is scattered in various State and Government publications, and the information most desired by the owner or forester is often not available."

Page 1: "This book is designed to serve a present purpose. We are using to-day methods in vogue in Europe many years ago. The methods of artificial seeding and planting are not included at all. I have laid special emphasis on the more primitive methods of forestry because of poor markets and difficult logging."

Page 3: "It has been estimated that the damage by fire since 1870 has averaged fifty million dollars each year aside from the injury to young trees and reproduction."

Page 6: "The definition of forestry is continuity of use. It is to utilize the present crop with the greatest economy and profit for the owner." "The forester regards a forest as capable of yielding repeated crops of timber, and therefore must be a man experienced in modern lumbering, and in the art of forest production."

Page 8: "There are millions of acres of devastated forest lands, on which it will be impossible to establish a stand of natural reproduction in less than a century."

Page 9: "Nature does not discriminate in species, often those of least value win. Thus in New England the ground is often occupied by birch, soft maple, iron wood and others of little value. Often a growth of inferior species take possession where the original growth stood; it is to improve the composition of the given area so that valuable species take their places."

Page 10: "Frequently trees are crooked, forked and low-branched that destroy their otherwise high value."

Page 12: "It is a proved fact that the growth of a natural forest is very much lower than in a cultivated one. Thus in the Adirondacks it requires 180 years for a spruce to reach a diameter of twelve inches." "One object is to give each tree the required space and light, in order that it may grow at its maximum rate." "A forester has to sacrifice increment to form and quality; for that purpose a certain amount of crowding is necessary." "There is for every type of forest a maximum of production which may however involve an investment which might not yield the owner a satisfactory return." "Under our present conditions it is not usually possible to secure maximum production of the forest and meet the financial requirements of the investment."

Page 15: "The application of forestry to secure a high production involving as it does a considerable outlay is called 'Intensive Forestry.' National forests and State forests are set aside, to be managed for the permanent benefit of the public."

Page 18: "The essential object of most private owners in Forestry is financial. Forestry to them is strictly a business proposition."

Page 20: "The net returns of the Prussian forests are about $2.50 per acre. The forests of Saxony yield more than $5.00 per acre per annum. A typical forest in Europe yields 2½% on the investment with compound interest."

Page 21: "A New England forest planting has been known to yield over 6%, and in the Prairie States, where small trees are valuable, an even higher rate has been secured."

Page 22: "The virgin timber of the past will be largely cut in twenty-five or thirty years, after that time it will be second growth." "Far sighted owners who protect their stands, will furnish the stumpage for the future. Their profits will be high partly through growth and partly through increased value."

Page 43: "In judicious mixture of species there are a larger number of trees than in a pure stand because of difference in crown and root development." "It has been actually demonstrated that a larger volume of product can be obtained in mixed than in pure stands."

Page 47: "If reproduction is secured, the older class could be removed in the first twenty years, and the next age class in the next twenty years and the process might be continued indefinitely. In some cases a stand is cut every year. In Europe the cutting cycle is about ten years."

Page 88: "In artificial reproduction, a new stand is established at once, natural reproduction often requires five to ten years to stock an acre with young trees. Artificial reproduction is more certain of success." "Trees may be given the right amount of growing space. The yield of high grade material is greater from artificial than natural reproduction." "Natural reproduction is usually cheaper, artificial reproduction requires larger initial outlay even though obviously more profitable in the long run."

Page 89: "Under the clear cutting with artificial reproduction method a specified area is cut clear—logs and other materials are removed and the stand disposed of by the burning or otherwise. The ground is then clear, and may be restocked by setting out young trees or by sowing seed. It is desirable to start the new stand as soon as possible, in order that there may be no loss of growth, and that the new trees may gain such headway, as to compete with the weeds and brush which inevitably spring up on new clearings." "The use of this system will increase rapidly, as the opportunity to practice intensive forestry becomes more common."

Page 90: "Many areas of the public forest for reproduction of desired species will not be difficult; as the knowledge of the methods of planting becomes perfected, the intensive system will be used, where now natural reproduction is relied on."

Page 91: "There will be in the near future many areas within the State Forests where an intensive system of forestry can be practiced." "The experiment of the Cornell University in the Adirondacks in 1899 and 1902 of clear cutting and planting on a large scale was the first instance in this country." "Owners of small tracts, who are interested enough to practice forestry at all are impatient to see results. They are not willing to wait ten or twenty years for natural reproduction to take place on a clearing. The cost of restocking by planting is not large. Not uncommonly the clear cut area would be not over five or ten acres."

Page 96: "The simplest plan is to clear out and replant. The New Haven Water Company clear cut two acres of hardwoods and restocked it artificially with white pine, at a cost for planting of about $16.00." "As the knowledge of tree planting progresses clear cutting with artificial reproduction will be used more and more." "It is the method of clear cutting the whole stand which will be used more commonly in this country. In many cases a restricted stand is cleared in one year. In larger areas, several years of consecutive work will be required to finish."

"We find here for the purpose of forestry it was desirable for trees to grow in crowded stands. The mutual crowding resulted in the natural pruning of the stems and the production of high grade lumber. In planting a forest the trees are set out from four to six feet apart or from twelve hundred to twenty-eight hundred trees per acre. As soon as the crowns meet and their growth is consequently restricted, the struggle for light, space, moisture and nourishment begins. Some trees forge ahead, while the weak trees as the stand grows older must have more space for growth, so that more trees are suppressed, and the suppressed trees are at last killed. There is, therefore, a rapid reduction of numbers simply by the natural struggle for existence."

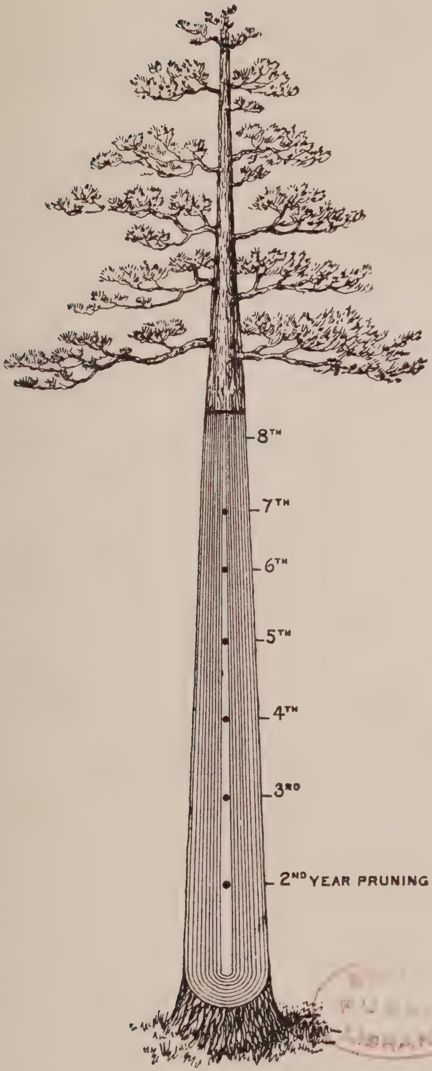
Page 199: "The crowding of a stand is beneficial in youth, producing clear boled trees, but later in life results in a great reduction of growth."

Page 200: "It is possible to bring a stand to a merchantable condition ten or twenty years sooner." "In Europe about thirty per cent of the yield is from thinnings. This is a surplus because the final yield is not less, and sometimes even more; by timely thinnings distortion of valuable trees can be prevented, and develop a higher grade, clear stems and even grain." "The aim is to give them the space required for their proper growth, with a view of a larger yield per acre." "In general the best results are obtained in making the thinnings moderate in the first half of their life, then after the main height has been reached thin heavily."

"Defective trees should be removed for the benefit of the stand." "Trees respond quickly to thinnings. The poorer the soil the greater the need for thinnings to secure good growth." "It would be a benefit if light thinnings are made early in the life of the stand, ordinarily between ten and twenty years." "The experience in thinning American species is so limited and the markets are so poor for the products obtained from them, that no data can be given as to the time of beginning the work of thinning."

Our system of annual pruning and cultivation overcomes the necessity of thick planting and the extra cost of the twelve to twenty-eight hundred trees all of which but one hundred and sixty to the acre sooner or later must be suppressed one way or another, nor need all the time (30 to 40 years) be wasted in securing through a thick stand a clean body or bole.

Page 223: "The pruning of forest trees is confined chiefly to cutting off the lower branches, in order to free the stems from knots, and to raise the grade of lumber produced. As a rule forest trees are not pruned at all, but there is a natural cleaning of the stems, called natural pruning by the loss of the lower limbs, resulting from overcrowding. The branches of white pine, even in crowded stands, often remain many years after their death, and produce loose knots. Very old white pine will produce clear lumber, but if it is managed on a short rotation it will yield very little clear lumber unless the trees are pruned. An unpruned stand, cut at fifty to sixty years, yields but little clear lumber, whereas if the trees had been pruned when from twenty to thirty years old, the wood produced during the last half of the rotation would have been free of knots."



Showing the effect of annual pruning, leaving knots in the center of the tree only.

"Pruning involves an investment, whose return appears in the increased value of the final product, and is practiced only when stands are intensively managed." "Usually not over one hundred trees to the acre are pruned and these selected for the final."

"The cost of pruning conifers is about two cents a tree at twenty to forty years old." "Forest pruning will not be practiced in this country except in small tracts intensively managed."

Mr. Graves has written a very interesting book, and from the standpoint of the time when it was written, and the conditions then obtaining, a very comprehensive and practical one, and any farmer about to utilize his woodlot on any method could read it with profit. Our quotations from his book could be confined to the general practice of his time and to his views on such subjects as apply to our system, but as he states in the preface, the book only deals with wood lands and their treatment. "The methods of artificial seeding and planting are not included." Yet sufficient allusion to it and intensive forestry is made for a close student to draw his own conclusions.

We have written scores of letters to the best authorities in the profession and to the Chief Foresters of all the states, with a view of ascertaining the result of planting under an intensive system.

It should not have been a question of whether it will pay or not, but surely the people have the right to know what method or system will produce a maximum yield of the best quality, for use when the time comes.

CHAPTER XVIII

"Studies in French Forestry," by T. S. Woolsey, Jr., Vanderbilt, Yale. Loblolly Pine

Page 115: "No attempt will be made to treat the subject of artificial stocking systematically."

Page 116: "Sowing is best according to the French writers, when plantations are made with difficulty, where seed is very cheap, and when the soil need not be previously prepared, otherwise it is more expensive." "Planting makes possible the control of the species, mixtures and spacing."

Page 125: "In planting Jolyet says: 'Cultivation should usually be considered indispensable, always advantageous.' As a rule the French favor wider spacings than the Germans. Bartet favors 6½ feet for spruce, more in accordance with American practice."

Page 127: "It has been found that the best time to plant conifers is in the Spring. The depth and length of the holes should be 16 to 12 inches. Paris authorities impose 10 inch squares but Dumer uses 16 inch spots. When 1600 to 2000 plants per acre the whole expense is $10 to $12 per acre; with labor at 70 to 80 cents per day the loss will vary from nothing to 60 to 70 per cent." "An exceedingly cheap method, with a high percentage of loss."

Page 130: "Jolyet advocates planting coniferous stands, but recognizes the force of the argument in favor of mixed stands, with some broad leaf trees, to assist in the preservation of the soil; he recommends the introduction of a very few exotics, and spacing 5′ x 5′ prepared 3 to 8 weeks before planting, holes 10 inches square, finish planting before April 1st."

No mention is made of the rate of growth from artificial planting; it is indeed evident that French forestry has been conducted for other reasons than quick results, probably for the very good reason that their wants for woodgoods could be supplied cheaper from the Baltic than from their own forests, and while less than 20% of their area is in wood land the large tracts are held more for their hunting and fishing privileges than profit. Yet their system of regeneration, practiced for ages past, played an important part in saving her from being overrun by the German army, but it at the same time furnished a hostile army the use of her protected forest to her serious harm as over 300,000 acres were denuded in the war zone of France.

While this work of Professor Woolsey is one of much painstaking research, as well as his *French Forests and Forestry*, and should fill a real want in the library of the student of forestry, yet there is but little that sheds light on profitable tree growing that applies to the problem that faces the American, European or Colonial farmer or the private owner of woodland under present day conditions. But his data and material for his book were gathered mostly before the war.

We have shown that our claim for an early harvest of the pulp wood is substantiated in street planting where intensive methods only obtain, both in planting and pruning, and if such methods bring such results in street planting, the same can be practiced so much cheaper in the forest under our plans.

In response to our inquiry from the Cornell University as to the growth of their Adirondack plantings referred to in Mr. Graves' interesting book, *Principles of Handling Woodlands,* we quote from a reprint of a report published in 1917, of examination of the twelve plantings of the University between 1899 and 1904, under the direction of Professor Fernow.

"The seventh plantation represents his treatment amply justified by results. Pine and spruce are alike at home and in vigorous growth. Perhaps the most successful planting seen was a slash grown up to aspens, which was planted without any preparation whatever, with pines and spruces vying with each other for first place. European larch over-topped them all, being 35 feet tall. The species deserving the blue ribbon, were our native white pine and the introduced Scotch pines and Norway Spruce."

The illustration from photographs taken at the time gives by comparison (with the man's size) a better idea at a glance than could be explained in pages. They not only show growth, but the disadvantage under which they have struggled. No pruning as indicated by the limbs still down to the ground and unthinned, the suppressed, the dying and the dead, on ground entirely unprepared, uncultivated, not fertilized, manured or limed, and littered with dry, dead limbs, leaves and undergrowth, a constant menace of danger from fire.

Had but a few acres, then, have been devoted to a scientific study of the intensive system, including annual pruning, what a store of knowledge that institution could have shed on the subject thus eliminating the guesswork of the fraternity. What an opportunity Cornell let go by to do something worth while in that Adirondacks planting twenty years ago. Had a few of those acres been planted and cared for by the intensive system in comparison with the methods pursued what a lesson it would have taught by this time.

Or those plantings of the government at Sinepuxent in 1900—or of the planting at Bowie in 1911 by the Maryland State Forestry Service.

Had even one acre been pruned and cultivated from the start, the question would be now well past the guessing stage, whether the growth by the intensive system had left the uncared for plot at the post or not, or if the quality of the tree would be improved or not, or if pruning retards the growth or not, or if cultivation protects the planting from fire or not.

The Forestry Service would at least be in a position to say "we have had experience in the intensive system."

During the early days of the growth there, cultivation to keep down "weeds and briars" "with which it was beset" need not have cost the State more than three dollars a year for three or four years, and the pruning not half so much. But for a farmer living on the spot with idle teams that estimate is excessive.

The lessons taught as to the pines mean nothing to Bayside farmers. They and their fathers before them have known what the Service there has proven, that is, transplanted loblolly pine will grow fast when well cared for; it did not teach anything new as to the difference in the growth of that tree compared with a scrub pine.

There is in many of those reports no lack of proof as to the benefit of pruning, of cultivation or of preparation of the soil and holes. But there is a sad silence on the combination of them as a whole in the artificial planting, growing and care of forest trees. When I realized the fact I was so stunned at the lack of information that I began to make personal inquiries.

Early in my search for information all data available was promptly to be had for the asking.

But later on when I began to ask specific and technical questions that suggested views at variance with the established laws governing tree growth, the attempt was made by a member of the profession to be-cloud them with technical nomenclature that might mean most anything or nothing.

Others volunteered the unasked advice that "it would not pay," that it was fanciful "but interesting," others frankly admitted "they had no experience," and they "really did not know" and still others shut up like clams or took to the woods; most of the latter class ignored the question, or referred it to the Forestry Service at the Capital. To question the validity of the established laws is rank heresy—those who have views of their own, whether in or out of the profession, are heretics.

CHAPTER XIX

New York, Cornell, Syracuse, Vermont, Indiana, New Hampshire, Kansas

New York. Eighth Annual Report of the Conservation Commission, 1918. Pages 100 to 109: "The legislature of 1916 authorized a referendum which was adopted at the next election for a $7,500,000 issue of bonds, for the extension of the forest reserves, which now total nearly 2,000,000 acres, at an average cost of less than $6.00 an acre," "the acquisition in 1918 of nearly 200,000 acres, indicates the interest in the subject is growing."

Page 111: "Notwithstanding the shortage of labor, upwards of twelve million pines of all ages." The restrictions under which white pine plantings may continue. First, "That the stock which is to be planted must be entirely free from disease." Second, "That the plantation be made on an area on which there are no currant or gooseberry bushes. Third, "That there be an immune zone of 500 yards around the plantations which is free of disease."

Page 112: "The total production of all of our nursery plants for the year exceed seven million." "The total number of acres planted exceed 4200, and the number of trees planted on that area exceeded 4,200,000, and during the same year 426,000 trees were furnished State Institutions for reforesting, and there were sold to private land owners nearly 2,600,000 trees."

"Eradications on 29,000 acres were worked for the suppression of blister rust at an average cost of $1.46 per acre." Much space is devoted to fires, their suppression and damage. "14 steel towers, at heights ranging from 35 to 60 feet."

Page 126: "The fuel shortage has offered unusual opportunities for improving the wood lot (refers to private owners); dead and defective trees for which in ordinary times there would be no market, could be removed, for even inferior fire wood has been marketable. Thinning and improvement cuttings to weed out the poorer trees, could be made at a profit. That this was a practical measure is obvious when one considers that the wood lot owners could sell their product at a profit, in addition to increasing the capacity of the wood lot to procure wood for the future."

There is nothing in this report as to growth by intensive methods or otherwise, but that question as to growth is fully answered as to the State of New York by the quotations from Cornell University and Syracuse Forestry School. But our other contention as to the demand and profitableness of the wood from trees already standing is fully met.

The activity of that service in that state and its accomplishments indicates their Solons are alive to the situation, and at the rate they are going their work will loom large in the near future. The time has not yet come for States to practice intensive methods, for many reasons. When there is already so much land idle and going to waste, the question of planting in the way the most acres can be covered in the shortest time is the important one for the present at least. Their seedlings and transplants cost so little the question of more or less number of plants is of less importance than with the private owner. The field for planting is so vast there, the question of pruning is secondary to planting, but when labor gets back to a wage that can be utilized on a larger scale, that state can do nothing in that line to yield more profit than in making annual prunings of the younger trees, and annual thinnings as soon as the young trees attain a commercial size however small, either for crating material or pulp wood. When that time comes close planting will be dispensed with, and the labor can be better employed in prunings.

Bulletin of College of Forestry, Syracuse, N. Y., March, 1915, Volume 15. Page 29: "Carolina poplar is a tree of very rapid growth, it is useful for planting only on country roadsides, and on village and city streets, as a temporary tree, between trees of more permanent character." (The trees shown in the illustration, page 29, have been planted six years, apparently thirty feet high, and six inches in diameter breast high.) "In about eight years more those trees will have their matured growth." "They may be allowed to grow unchecked 12 to 15 years, and the tree then removed." "This poplar should not be allowed to remain even as a temporary shade tree more than 8 or 10 years longer."

Page 30: "Trees should be grown in a nursery specially for street planting; when trees are ready for transplanting the top and roots are pruned." (For shade but not for forest trees.)

Page 31: "The best method when there is space is to plow the ground the same as for a garden crop. Make a large deep hole, and put some top soil in the bottom. If the sub-soil is of a sterile nature there should be an addition of bone meal, lime or some other equally good fertilizer; in proportion of 2 pounds of lime to one pound of bone meal to a cubic yard of soil in most cases will be sufficient." "A good soil condition is the foundation for successful tree growth."

Of course such preparation cannot be given to forest tree planting, but it is recited here to show the difference in planting for the best results, and the lick and promise plan recommended simply for its low first cost, but it is not cheap—anything is dear that cannot produce results.

"The top branches should be pruned to balance the reduced root system."

Pages 34 and 35: "Trees that are liberally spaced and planted on favorable soil, a growth of five years will cause the trees to spread over a considerable space." "Quick growing trees may be planted with species for permanent use." "Trees used for immediate results should never be retained more than seven or eight years."

Page 41: "It has been said it requires no more work the first season to care for the newly planted shade tree than to grow a hill of corn."

Indiana. Report of 1921 State Forester, page 285: "The first sycamores were planted nine years ago, they are thrifty and have made a rapid growth, the largest are 40 feet high, and six inches in diameter." "The sycamores in six other tracts, except on the very highest ground, are all doing well."

We take the report of the State Forester of Vermont for 1916 which appears to be the last, from which we quote, Bulletins 20 and 193:

Page 11: "The state nursery has been in operation for ten years." "There has been a healthy growth in the demand." "Which grew so rapidly that increased capacity was recommended, as it requires three years to bring seedlings to the age for planting."

Page 16: "It should be the policy of the department to spend its funds for the next few years, in ways which will be of greater educational value, than in making extensive plantations on mountain slopes, as much as they are needed." "Demonstration forests are selected principally for their educational value." "So far as possible they are also selected with regard to special forest problems to be studied, without expected profit to the state." (It is extremely unfortunate that those special problems have not already been worked out, because of the time required to prove anything by waiting the slow process of tree growth. That surely is what the private owner has a right to expect from the State before the State could expect him to engage in a business that still had to have "special problems worked or studied." They should have been worked out twenty years ago.)

The report of the *State Forestry Department of New Hampshire* for 1920. "Suggestions for Spring Forest Planting." "The Forestry Department has some unusually good three year old transplanted stock for distribution to private owners within the State this Spring." "White pine is the best tree for general plantings, but not adapted to high elevations, swamp lands, or very light lands without shade." "Red pine is a fair substitute. Scotch pine is a rapid growing but inferior as a lumber tree." "Planting trees the standard spacings 6′ x 6′, about 1200 trees to the acre." (The usual direction for low first cost.) "Price of white pine, red and Scotch pines and Norway spruce, $8.00 per thousand." (White pines now are offered at $6.00.)

The report from the *Division of Colleges of Kansas for 1916.* "Tree planting in Kansas." "The trees originally were box elders, soft maples and cottonwood, all of which have a life span on the uplands of about 30 years. The opportunity to replace common trees with good ones should not be neglected. Such trees as black walnut, sycamore, elm and oak, have greater resistance against dry weather than the common kind." "While the better trees make a slower growth, permanence is the essential in the new tree planting."

Instruction for Planting: "Success in growing trees is dependent on three factors: First, the selection of the trees suitable to climatic conditions; Second, the proper preparation of the soil, and careful planting; Third, cultivation and protection after planting."

Preparation of the Soil: "Is next to selection the most important step in tree plantings; soil in which the tree is to be planted should be spaded several weeks or months before planting time. If the sub-soil is loamy a depth of from 18 to 20 inches will be sufficient. The loosened mass should be shoveled back in the hole to absorb and retain the moisture."

Time to Plant: "Late in March or early in April." "Loosening and aerating the soil liberates the plant food and induces vigorous growth." "Trees should be set in place about the same depth that they grow in the nursery, covered with three or four inches of soil and tramped firmly." "After the trees are planted they demand as careful cultivation as any crop."

Page 11: "Cultivation conserves the soil moisture by preventing evaporation, and keeps down other vegetation, which would use the moisture needed for the trees." "The cultivation need not be deep, the more intensive the cultivation the greater the success will be."

Page 13: "It is often desirable to plant quick growing short lived trees, in mixture with the permanent trees; when this is done the trees may be spaced 16 to 20 feet apart and the temporary trees alternate." (Kansas furnishes to her own people trees true to name for planting within the State at the minimum cost, from its own nurseries, and affords helpful advice and encouragement for tree planting by practical and proven methods, intensely modern.)

Kansas does not say for what purpose it plants. If for forest trees the spacing is wasteful of land, as it is capable of producing an intermediate crop and of better trees if artificially pruned yearly. The object of this book is to teach the best method.

Kansas only needs, in the reproduction of forest trees, proper spacing and annual pruning, in addition to her practice above quoted to get maximum results if proper selections are made, and the intermediate crop saved in artificial tree growing.

Her practice is more advanced than any State in the Union, as indicated by her published reports but they are not presumed to apply to forest trees; its system fits into its present needs—for wind breaks, improvement of the landscape and purposes other than for growing woodgoods, as it is not a land of idle woodlots; her fertile fields are better employed.

CHAPTER XX

Ohio, Oberlin, Kenyon, Michigan, Mississippi, and Louisiana

Ohio. Sixth Annual Report, Agricultural Experiment Station. Bulletin 276, Forestry Operations.

Page 317: "It is the policy of the station at Wooster to have on hand a variety of nursery stock to be used in the various stages of experimental planting, which is being carried on throughout the state." "No particular effort has been made to keep on hand sufficient stock to supply the demands of forest planters. State institutions are supplied free of cost, others are charged at the approximate cost."

Page 319: "The experience of the Station does not encourage the gratis distribution of planting stock." "Experimental forestry should be years in advance of practical forestry." "Ohio conditions are unlike most other states, and we have much to learn from experience."

Page 320: "The farm wood lots in Ohio present numerous and difficult problems." "We do not want wood lots to reproduce iron wood, blue beech, black gum and other similar weed trees." "Many operations are simple of solution, that clear cutting with artificial planting should be made." "The average farmer is inclined to establish forest plantations on good agricultural lands, and not consider the possibilities of his native wood lots." "There are in Ohio approximately 4,600,000 acres of woodland."

"A survey of thirty counties shows but 16% unpastured, 33% pastured, but containing sufficient young growth, and capable of reconstruction by the exclusion of livestock, 51 % so pastured that reconstruction is impracticable." "Something must be done to conserve the remnants from the practice that threatens to leave us treeless." "In Ohio, good soil, good climate and a sufficient remainder of the old stand makes it possible to establish good commercial forests everywhere providing wood lot grazing is stopped."

Page 321: "There are many thousand acres of so called forest lands in the state held at a loss by the owners for the reason that it pays neither as forest nor grazing land, it is a negative proposition from every aspect."

Page 322: "It is often more profitable to start with the remnants of the wood lot, as a nucleus, battered though it may be, than to attempt planting on tillable land; matured trees can be marketed, weed trees, dead, crooked or distorted individuals removed. The practice of wood lot forestry brings immediate financial results."

Page 324: "Oberlin Municipal farm of 100 acres is now practically reforested, by a combination of artificial planting and a natural regeneration." "Kenyon College, plantings covering four years are giving good results particularly the white and red pine plantations." "Ohio State Sanitarium planted 3000 red and white pines in 1913 with minor loss, notwithstanding the dry season following."

Page 328: "Forest planting will play an important role in Ohio forestry, although it must take a second place in importance, the management of the wood lot must come first." "While much of the work in the wood lot calls for clear cutting and subsequent planting, there are still greater areas of forest to be managed through systems of proper cutting and reproduction." "The experiment station will supply land owners with trees at cost."

Bulletin No. 158, 1905.

Pages 143 and 144: Photograph Figure 2 and 3 shows the very decided advantage in early artificial pruning.

Page 150: "Young trees need to be cultivated or mulched two or three years after planting." "The ground may be put in better condition at the beginning of the second year with a disk harrow." "At the beginning of the third or fourth year clover seed may be sown and if a crop is secured it may be left to enrich the soil." "Distance apart 4 x 4 Catalpa, in every case where trees are four feet or less apart, those on the outside the average diameter is twice as great as those on the interior of the grove."

Page 154: "Estimated height of locust 18 years old 8 x 11, note tall straight growth 40 to 45 feet high with but little greater diameter at the ground than 10 to 20 feet above the ground."

Page 156: "A farmer who plants a grove of trees for posts can afford to give the needed space and time for prunings in order to secure quick returns. He cannot afford to let nature take years to do a little pruning which he ought to do in a few days."

Bulletin No. 254, 1912.

"The forester, no matter how deeply his knowledge may extend, cannot outline a plan of improvement based on concrete examples because such do not exist in America to-day." "We have pursued the experimental vigorously and will ultimately give to the people of the state the information they will be seeking within a few years." "Wood lot operations must be intensive, yet conditions that exist to-day are directly opposed to intensive forestry, because there are no available markets for waste products."

Photo by F. W. Besley

State Forest Nursery. Norway Spruce middle foreground. White Pine to the right and Loblolly Pine to the left.

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Photo by Courtesy U. S. Forest Service

Western White Pine transplants, Savenac Nursery, Lolo National Forest, Montana.

The following is the Biennial Report of the *Public Domain Commission of Michigan* of 1918.

Page 106: "The Forestry Nursery of Higgins Lake, with more than 1500 seed beds alone with only ½% of failures is a delight and a surprise. Millions of young pines, in most excellent condition, for the struggle they must meet when set out on those barren sands of the much abused cut and burned over lands." "In 1904 the first beginning was made, now present development proves the choice of site a perfect hit." "But the nursery does more than prove a good nursery, plant stock is raised here at small expense (generally below $1.00 per thousand)." "Nothing can be more convincing of the value of pine as a proper crop on these lands." "In perfect agreement with the French pine plantations on the poor sands of the 'Landes,' as well as the best German practice."

Page 111: "As an additional sign of the times the doubting Thomas might read the recommendation of the British Board of Reconstruction which asks Great Britain to put sixty million dollars into a planting program." Michigan like Pennsylvania has a vast cut over pine area; they are preparing on a very large scale to continue the work; in both cases the slower growing pines predominate, hence their work is rather for the future than for any immediate relief of a situation that is now at our very doors. For the present the intensive system is only for private planting in that State.

Report of the *Superintendent of Forestry of Louisiana for 1921*, Bulletin 7.

Page 5: "When the Spaniards first came to Louisiana, and the French descended the Mississippi, they found an unbroken forest stretching from about New Orleans northward. The only portions not wooded at that time were the sea marshes, and the prairie region of which Acadia is now the center."

Page 6: "The needle bearing trees, such as pine and cypress, have furnished the bulk of the lumber in Louisiana." "We cut six times as much pine as all other kinds combined, the best known of which are the long leaf, short leaf and loblolly."

Page 7: "Much smaller trees can be used for pulp wood than for lumber."

Page 9: "Clearing away forests to make farms is perfectly proper, and we hope for ability to clear and cultivate more and more land. In the course of two or three generations we should clear several million more acres of forest lands, for growing corn, cotton and cane."

Page 10: "For many years lumbering was confined to the Atlantic Coast states where population was more dense, principally the original 13 Colonies; as our population increased from a few million to a hundred million, our virgin forests that extended over most of the Eastern states have been cut over and now have to depend on the South and West for their lumber." "It is within the last 20 years that Louisiana began to send her forest products to the four corners of the world."

Page 19: "Twenty years from now there will be very little of our virgin timber left of any kind."

Page 20: "Total area twenty-nine million acres; cut over lands 12¾ million acres, virgin forest remaining January 1, 1921—4¾ million acres." (In a great state with such magnificent forests as Louisiana had scarcely touched thirty years ago, these figures are appalling, with only the great state of Washington exceeding her in an annual output, and when Louisiana is completely denuded the North, East and Middle States can then only look to the Pacific Coast for supplies until the next forest, yet to be planted, shall attain a useful size.)

It is not too late for the Gulf States to hope for natural reproduction, and their lawmakers are alive to the situation, and are providing that a certain number of seed trees be left for natural reseeding. She has locked her stable door in time. Many of the Atlantic Coast states are too late for that kind of protection. So it must be for the farmers nearby the great markets to be the first in artificial planting, together with the good work going on in the States and the National Forest Reserves, that is to avert a calamity.

Page 27: "Cord wood and pulp wood located near the railroad or large city is worth $2.00 per cord, on the stump. Fifteen years from now this price is certain to be higher. It is therefore plain that the growing of loblolly pine for cord wood or pulp wood in farm woodlands, of average quality, is a profitable undertaking, yielding well above 6% compounded annually." "It should be possible to thin out young timber to secure faster growth, larger yields and lower cost of production."

Page 34: "$5.00 to $6.00 per thousand is received today in North Louisiana for second growth saw timber stumpage."

We have the report of the *Mississippi Department of Agriculture and Commerce* for March 16, 1921. "Mississippi has no Forester, nor is the State doing any active work in reforesting the cut over lands; however, a Reclamation Commission has been appointed to study the State's needs along that line, and to make recommendations to the next legislature." Mississippi has a large wooded area with much cut over lands, but no large cities, and it is quite natural that her people will be about the last that will be stirred with the importance of the question of artificial reproduction. A denser population there would most probably be more interested in clearing some of her rich soils for farm crops than improving the woodlands, but her next legislature will be most derelict if the question of natural reproduction by seeds from mother trees is not provided for.

There the question of drainage is one for the public, before which progress in her forests will be slow.

Yet many fields are open to her enterprising people for experimentation; not the least promising is in thinning and pruning the young growth to hasten and improve the quality of the left-overs.

CHAPTER XXI

Tennessee, Florida, Alabama, Rhode Island, Kentucky, Texas, Nebraska, Colorado

State Geological Survey of Tennessee for 1912, Bulletin 10-b, page 1: "Chestnut because of the extensive and rapidly increasing use of its wood as a source of tanning material, has become one of the most important forest trees in Tennessee. Low grade chestnut wood of small pieces, including the bark, can be used for tanning stock. Chestnut has a comparatively rapid growth. Its yield can be augmented by protecting the forests from fires, and by thinning young stands."

Page 12: Table 1: "Trees of first quality show at ten years 33 feet high, 20 years 55′, 30 years 73′, 40 years 84′, 50 years 92′."

Page 17: "The object of thinning is to accelerate growth, thinnings should begin between the 15th and 30th year, according to the density of the stand."

Page 19: Table 3: "Shows at 45 years 330 trees yielding 4220 feet of lumber, on unthinned stands, and at 47 years 232 trees yields 18,800 feet on thinned stands."

Tennessee Bulletin 10-c, 1913.

Page 1: "On the basis of present cut of lumber yellow poplar (tulip tree, or white wood) ranks as second tree of importance in Tennessee, about 16% of the total of the United States, the total stand of 2½ billion feet remains" (8 years ago). "Yellow poplar has a comparatively rapid rate of growth while young." "No other species of tree which has such a wide distribution in Tennessee offers such excellent inducement for the protection of small trees, and even for propagation and planting."

Page 8: "The greater portion of the pulp wood comes from young trees, of pole size. "Yellow poplar may be surpassed occasionally in diameter by sycamore, and in height by cottonwood and spruce pine, but none of these equal poplar in both dimensions in Tennessee."

Page 16: "Tests by U. S. Forest Service show poplar has the highest sharing and cross breaking strength for packing boxes, for its weight, and cottonwood ranks next to it."

Page 30: Table 12: "Price of poplar 1st and 2ds 1893, $24.00, price in 1903 (10 years later) $53.00, an increase of a little more than 15% annually; present prices of those grades are more than four times as in 1893; stumpage value has increased at a higher rate."

While we cannot hope to cover the whole ground of commercial trees, those named and described are of those that will be used first and last more or less at "Lotuswood," and such as should meet with success in any of the Eastern and Middle states, with more or less discrimination against the far North and the far South in some of the species.

We have the report of the *Department of Agriculture of Florida*, Quarterly Bulletin, for April, 1916.

Page 5: "Florida has probably a larger area of forest lands than any state in the Union; of the 35,000,000 acres, 27,000,000 acres are in forests, January 1, 1911."

Page 7: "Long leaf pine is the prevailing tree, north of Osceola County; slash pine (miscalled by some writers

Cuban pine) south of there; about six million acres are treeless including the Everglades."

Page 16: "491 saw-mills cut the preceding year nearly 1¼ billion feet, not counting laths, shingles, packages and crates, cross ties, posts and fuel, nor the thousands of acres of long leaf pine wood shipped for fuel for drying the phosphate."

So long as population is so sparse in all the Gulf states there can be no interest in reforestration. And for years to come more and more acres will be cleared for farm crops and fruits. The reports show no data as to the percentage of her 27 million acres of wood cut over or burnt over. It is evident where loblolly has a chance, natural reseeding of that species will generally follow long leaf, whether cut over, burnt over, or destroyed by being bled for turpentine. Provision by law for mother trees for natural reseeding would be a wise movement there.

The following is the report of the *Department of Agriculture of Alabama for 1919:*

Page 163: "Of the 32 million acres of the total area of the state 65% are in wood."

Page 164: "It is probable the day of the large individual operation is passed." "It has been established beyond question that the texture of Southern pine is admirably adapted to paper making." "An important item among the products of Southern timber consists of turpentine and rosin, known as naval stores. The annual output of these in 1910 was valued at 2½ million dollars, and the product was increasing rapidly." "It is probably true as of other wooded regions of the United States, that lumbering operations in Alabama began at least a generation too soon, a time when the supply of good timber was so plentiful that it had very little value."

Page 97: "Alabama ranks second in the United States in area of stumpage of inferior timber lands, having 14,785,000 acres, and 900,000 acres of swamp lands." (If deducted from the 21,000,000 acres in wood, will leave a little over six million acres of virgin timber in 1910. While the state is rapidly approaching denudation, there is time yet to provide for reforestations by natural process, if mother trees are required by law to be left for that purpose. Alabama is too sparsely populated, and too far from the great markets to practice artificial planting on a large scale.)

Page 68: "There are pecan trees in the state a century old still vigorous and bearing abundantly. Trees at Union Springs, Alabama, at 16 years measure 62 feet high." "A seven year old grove at Fort Deposit of 80 acres sold for $22,500." "A grove of 25 acres at Camp Hill at 6 years old produced 17 lbs. per tree." "At Citronelle in a three acre orchard at five years old one tree produced 10 lbs. of nuts." "One acre planted in 1910 produced 919 ½ lbs. of nuts selling at 40 cents per pound." "These trees are planted 40 feet apart."

This is from the Fifteenth Annual Report of the *Commissioner of Forestry of Rhode Island for 1921:*

Page 3 & 4: "Southern pines will soon be exhausted and the prices will soar higher than ever before." "The following prices at local yards: Basswood $200.00, Oak $240.00, Hemlock $60.00, Sugar Maple $180.00, Ash $250.00, White Pine first quality $260.00 per thousand feet." "A stand which approaches maturity at 50 years appeals to the average farmer more than one which requires 75 to 100 years." "However, here in Rhode Island

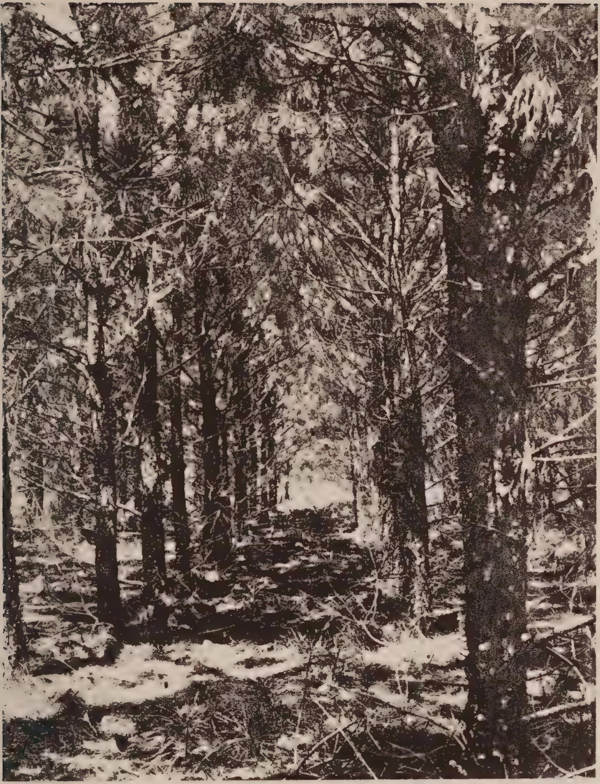

Photo by Courtesy U. S. Forest Service

10-year-old Loblolly Pine plantation, Dorchester County, Maryland. Height, 20–22 feet. D. B. H. 3–5."

Photo by Courtesy U. S. Forest Service

where the market for cordwood is very good there may be large receipts from the thinnings of old stands."

Former Chief Forester Graves says: "Too little emphasis has been placed in the past upon the importance of thinnings as a source of intermittent income. A forester's statement, that it requires perhaps fifty years to mature a timber crop, is naturally discouraging to a man of middle life. The fact is, however, that in any well regulated wood land periodic cuttings can be made, removing always the poorer varieties and inferior specimens, giving the best trees an opportunity to develop into the most valuable class of lumber. The utilization of this material, which usually goes to waste, adds appreciably to the income which the owner eventually drives from the high grade stock at the last cutting."

Page 5 & 6: "In any town in this State an acre of well stocked natural forest can be purchased for less than the cost of planting an acre, with forest nursery stock." "Almost one-half of the area of the state is in forest."
"Forest conservation is a fundamental condition of permanent prosperity to any state having a large proportion of forest land. Forest fires hurt everybody, the nation is facing a real timber shortage." "Planting is not advisable, in any region not protected from fire."

Cultivation, and annual pruning, the two combined agencies that properly, cheaply and effectively dispose of "the grasses, leaves and litter," and every year get down to "the mineral soil" by the most economical means of a two or three horse disk harrow, and while fire proofing the forest, returns the humus to the soil thus maintaining its productivity and at the same time creates a mulch to conserve the moisture effectively—such methods cannot be economically handled in a slipshod fashion. There must be a systematic plan; besides the orderly arrangement of the rows, we want to know we are using species of commercial value and quick growth, nature does not discriminate, artificial methods do.

Kentucky from the *State Bureau of Agriculture* Reports, 1919:

Page 31: "Total area of the state a little over 23,000,000 acres, of which about 16% is in timber land." "Since 1912 the Forestry Board has ceased to exist."

Texas, Bulletin 13, 1920.

Page 1: "Tree planting for fuel, posts and shelter." "Not only do the farm houses in the Plains region appear desolate due to the lack of trees, but they actually lack comfort of the homes further East." "Tree planting is badly needed on the farms of Western Texas." "The annual rainfall amounts to 14 to 32 inches." "Under these conditions any action that can be taken by the farmer to conserve or increase it would be a boon." "To a limited extent tree planting can bring about this result." "To that extent trees tend to increase the rainfall in a given region."

Page 8: "A recent government publication states that if 20% of the area of the plains country were given over to tree growing, the remaining 80% would produce as much as if the whole had been devoted to crops."

Page 9: "Planting may be made from seedlings or transplants while cuttings of some species are used."

Page 12: "Forest nursery stock is produced on a large scale at the Trout Experiment Station" (the usual directions for handling the nurseries are carefully given).

Page 13: "After the stock is one year old it is ready for transplanting in the field, certain evergreens should be left for two or three years." "Spacing should be 6 x 6 and 8 x 7."

Page 14: "Individual holes dug with a spade after the ground is well prepared and marked off with a marker." "Poplars, cottonwood and willows may be propagated most cheaply by cuttings. Sticks from 15 to 18 inches cut from branches from the mother tree and about a half of an inch or more in diameter, planting in the early spring just as the buds are ready to swell."

Page 18: "Rows must be spaced wide enough to permit horse cultivation for a number of years to stimulate growth." "On the poorer soils and when rainfall is deficient cultivation is essential to good tree growth, weeds must be kept down, weeds and trees cannot thrive in the same area. Fall cultivation is not desirable." "Cultivation takes the place of leaf mulch found in the forest, it is a soil moisture conserver and as such needed in the dry seasons." "The suppressed trees should be removed from time to time, all diseased trees should be removed." "Where trees are spaced too widely pruning must be resorted to if straight material is to be obtained."

Handbook of *Nebraska* Trees. Bulletin 7, 1919.

Page 3: "This state has less than 3% of its area in natural timber." "The thousands of planted groves dotted over this state have done much to make our broad prairies more inhabitable, as well as more beautiful." "So in various ways our people are greatly interested in the different kinds of trees that add so much to the joy as well as the profit of living."

Page 23: "Western yellow pine. The most extensive yellow pine forests in North America are the Western yellow pine forests of Arizona and New Mexico. The most extensive forests of Nebraska are also composed of this species." (The illustration on page 22 of the seed, cone and leaf and the description on the opposite page indicate a very near relationship to our loblolly pine, if not the same. This report is given over entirely to a minute technical description of Nebraska trees, but with nothing relating to its planting methods of any kind.)

The Colorado Extensive Bulletin, Series 1, No. 123: "Tree planting for beautiful homes and for economic reasons is only beginning." "Successful tree growing is shown by early plantings, is possible and practicable in spite of unfavorable climatic factors, but success is dependent upon proper choice of species, correct planting methods and subsequent care."

Page 7: "Broad leaf trees may be planted one year old, such small stock is cheap and more likely to survive." "The evergreens should be at least three years old, one or two of the three having been spent in the transplant beds." "State Forester will furnish trees at cost." "The broad leaf trees require more moisture than the coniferous trees, and consequently need more cultivation."

Page 11: "The earlier the trees are planted after the first or middle of March the better." "Prairie soil should be cultivated a year or two before tree planting." "Conifers may be planted in furrows in which slits are made with a spade, but usually this method is not careful enough for best results; as the trees become sizable thinning will be needed. Plant the tree firmly and carefully, this is essential in successful tree growing."

Page 14: "Cultivate cleanly and frequently as you would a fruit orchard."

CHAPTER XXII

Wisconsin, Minnesota

Wisconsin: Forest Planting Bulletin 1, Revised Edition of 1920, states: *Page 3:* "A forest does not need to be merchantable to be valuable." "In 1911 the State established a nursery at Trout Lake and about one million seedlings were raised. They now raise that many every year, much of which is used in the State forest reserves, an increasing amount of the stock is being purchased annually, with an increasing demand." "Forest planting is advisable on rough lands, farm lands, cut-over lands, bush lands, timber lands incompletely stocked, windbreaks and farm woodlots, or a treeless area to be added to it. In all cases some cultivation will be a great benefit to the growing trees. Spring planting is the best."

Page 10: "The cost of planting on State lands has been from $7 to $10 per acre. Cost of private plantings from $8 to $17. As forest planting was so recently begun in Wisconsin no cost figures are at present available; if it does not vary from the cost of other states planting in Wisconsin will net fair returns.

Page 26: "Price of nursery stock white pine seedlings $1.50 to $2.50 per thousand trees. Red and Scotch Pine the same. Three year old transplants $3.50 to $5.00, four-year old transplants $4 to $6 per M."

Page 27: "Forest plantations exempt from taxation. Not exceeding 40 acres, land must not exceed $10 per acre at time of planting and must contain 1200 trees per acre."

The first 40 pages of the Minnesota report, Bulletin 169 for 1917, are devoted to gathering the seed, their care and planting in the nursery beds, the transfer of the seedlings for transplants, all in great detail.

Page 40: "One of the principal studies of the Cloquet Station has been reforestation, the object being to fix a standard for determining the type of soil in the Lake regions." "After the types were determined the next problem was that of determining the class of stock and the methods that would give the best results." (The stock used in this experiment was 2–0 and 3–0 seedlings and 2–1, 1–2, and 2–2 transplants, in each plot of about half an acre 500 trees were planted. The average results quite conclusive. Some of these acres after four years have a stand of over 90%.)

Page 45: Table X: "Shows advantage of heart shovel (Ames long handle) in both economical planting and high percentage of living after two years." There are at Cloquet Station 360 plots of half acre each to test the classes of stock, 500 trees are planted in each plot, on cut-over areas, plants 2–1 white pine show 88% alive after two years, 1–2, 76% and 3–0 seedlings 61%. Table XII "shows the percentage of alive white pine after two trials between fall and spring planting is slightly in favor of spring, 98%—95% respectively, with transplants 2–1, and 99% and 96% for 1–2 transplants." "With white pine and Norway best results as shown in Table XIII seem to be with 1–2 transplants." Table XIV "shows percentage of alive after second year of white pine forest (pulled stock) to be 57%" (as against the above high average of nursery grown stock).

While these tables are of special value from a technical point of view they prove several points already well known by the layman.

First, the advantage of nursery plants over forest grown plants.

Second, the advantage of transplants over seedlings, for direct planting.

Third, the advantage of the Ames farm shovel over any other special tool for transplanting.

Fourth, the advantage of spring planting.

Had these experiments been carried to completion years ago, the results would now be beyond the argument stage, and these extensive quotations need not have been invoked for proof. They, however, demonstrate the almost universal interest that is so manifest in the cut-over and treeless states. These quotations may appear tedious, and of much sameness, yet we think to the student or investigator, there is not a single one that does not point to or carry a lesson of value, the sum total of which is knowledge and truth. Well worth the most thoughtful study of the economist, the farmer, the private owner of timber and cut-over lands, the layman, public official and the wisest Statesman.

It will be observed that plans were well under way for reforestation in many States before the war; they were not only postponed on that account, but excessive inroads on the nearby supplies were so great as to emphasize the necessity of prompt action, as was not anticipated until we were face to face with a serious condition.

The most encouraging sign that we glean here is the extensive nursery plants of several states for furnishing young trees, of healthy growth, true to name and at reasonable price. It removes at once the most serious problem that had heretofore disturbed the mind of prospective planters.

CHAPTER XXIII

Australia, New South Wales, Victoria, Queensland, South Australia, England, New Brunswick, Ontario, and Manitoba

Report of The Forestry Commission of New South Wales, Commonwealth of Australia, Sydney, 1920, to Imperial Forestry Conference, held in London, July, 1920.

Setting out the present position of forestry in this state, considerable space is devoted to topography, geology, soils, climate, rainfall and coal bearing regions, and (somewhat lengthily) descriptions of the many species of forest trees, of which the Eucalyptus has even more varieties than our pines. While there seems to be besides what they call the native pines, a very inferior wood of scrubby growth, "The Hoop Pine" and "Bunya pine," are the most important, but constitute a very small proportion of its timbered lands, "growing in natural stands 10 to 20 trees per acre; the biggest trees furnish up to 6000 feet of sawn timber, and are sold as Queensland Pine without discrimination." "The Cypress Pine is a coniferous hardwood, aromatic but somewhat knotty and brittle. It has special value to the foresters because it can be grown under droughty conditions."

Of the total area 5½% is merchantable woodland, the remaining 94½% includes all other lands. The report of Queensland gives 2½% to agricultural lands, 1½% to merchantable timber lands, and 96% to all other lands. The report from Victoria gives the following area: Agricultural lands 50%, merchantable forests 5%, unmerchantable or inaccessible forests 9%, the remaining other land at 36%. That of South Australia does not give the total area, but of the approximately 160,000 acres, 16,000 are in plantations, 94,000 slightly wooded. Without having the data of the total area of that state before us we are not able to give the percentage in woodland, but it is apparently much less than one per cent. So it is plainly evident that Australia is intensely interested in the question of reproduction and especially of afforestation (that is, making forests where they never were before).

While we have before us the reports of Queensland, South Australia and Victoria, as well as New South Wales, all in much detail, to follow them up separately would take more space than we have to spare, and as we are interested only in the question of artificial planting and production, our quotations will be confined to those features of the several reports as we come to them. From a casual reading of them it is apparent that forest growth there is adversely affected by climatic conditions, and extreme variations of rainfall, besides those named as inaccessible, and arid, with a growth of bush brush and stunted trees, among which are many pasture lands.

The object of the conference was to ascertain the timber resources of the British Empire, or of the United Kingdom and her Colonies, after the inroads made on their timber resources during the war, and to provide the ways and means of restoring its wasted forests and stocking some of its treeless regions.

British Empire Forestry Conference South Australia says, page 8, Part XIV: "It is not possible to estimate how far the quantity annually used exceeds the annual increment, though it is safe to say it far exceeds the amount produced. It is therefore expected that the importations of hard wood will continue, but it is anticipated that the pine plantations now established with those that will be created under a vigorous forest policy will ultimately overtake the demand for soft woods and equal to the state's requirements."

Page 15: Part XLV: "The reason for the serious overcutting taking place in Queensland is the operation of private landholders who are all realizing timber values immediately with no thought of the future. The position, however, is that the immediately prospective resources of timber are barely sufficient to meet the requirements at the present rate, much less to meet the increased demand the future must hold."

Page 15: "Summary of steps necessary to protect forest resources of Victoria." "Apart from the essential condition of conservation forest management, which will keep the annual outturn of forest products well within the mean annual yield, there must be extensive plantings and sowing of useful Eucalyptus on the almost treeless Northern plains, and the conifers along the watered slopes of the Dividing Range, as well as on the sparsely timbered or at times treeless area of the Southern coast." (Of conifers alone, in order that the State may gradually meet the requirements, the annual planting would be 5000 acres;

over 250,000 acres are available with an assured rainfall on the Southern coastal districts alone.)

Page 13 (B): "At the present rate of cutting the Hoop Pine resources of *New South Wales* will be practically exhausted in 12 yrs." "A vigorous policy of afforestation with exotic conifers, fire protection and fire control, the control of grazing and the extermination of the rabbits are essential for the protection of the young crop."

Page 6, Part VI: "The planting of waste and poorly timbered areas in *South Australia* has for over forty years been a prominent feature of the Forest Department's operations, and although the hard woods planted have only gradually yielded produce of value, seeing that at least 50 years are needed to mature them, the pine plantations have proved beyond all fear of contradiction the high value to be attained by them. Recently a plantation of 19.2 acres has been sold and clear cut, has been accurately measured; the returns show 98,000 superficial feet to the acre as the result of 37 years growth, giving an average annual increase of over 2,600 superficial feet per acre."

(*C*) "The department has distributed in 38 years over Ten Million trees."

Page 10, Part VI: "The Forest Service of *Queens and* is not fully developed. The limited staff cannot deal with the large area involved (670,000 sq. miles); operations confined to the more closely settled areas near the chief markets." "Forest nurseries have been established. Experimental plantings are also being undertaken, chiefly in Hoop and Bunya pine." "Water is being supplied in the drier reserves by means of sub artesian wells, tanks, dams, etc., for nursery and domestic use."

Page 6: "The regeneration of New South Wales has been prevented by the rabbit pests, and by the grazing of the sheep."

Page 9: "Afforestation of waste and unproductive areas is now receiving attention. The proposal of the commission contemplates the introduction of exotic conifers to areas which are not capable of producing valuable trees of local species. Nurseries have been established for the production of planting stock. The area planted during the current year will approach 1,000 acres, and a progressive increase." "A notable exception, however, exists in the Ballarat Water Supply Commission. This body supplies a total population of nearly 50,000 people, and has established extensive plantations of pine and other exotic (foreign) trees." "These not only conserve the rainfall and beautify the reserve, but also produce timber of commercial value; the receipts from this source in 1916, '17 and '18 were 6,657 pounds sterling, about $11,000 a year (from about 4,000 acres)."

"The Australian Forest League was founded in Melbourne in 1912 with branches in each state of the commonwealth." "A forest school was established near Ballarat, the capacity now is limited to 17 pupils between the ages of 14 to 17 years. They attend classes daily in the forenoon, and in the afternoon work in the young state nurseries and plantations. The capacity of the nursery is 3,000,000 plants, mostly conifers, the more important being Monterey pine, Corsican pine, Chester pine, Western yellow pine (U. S.), Douglas Fir, Redwood and Sitka Spruce" (all foreign).

Page 12: "The average annual increment of home grown timber is estimated at 360 superficial feet." "The only wood goods exported from Victoria during the war was 360 tons of Eucalyptus oil to the United States and Great Britain." (For medicinal purposes largely.)

It will be seen from these excerpts that the foreign pines are solely used for transplanting, there being no native tree of such rapid growth. Australia's problems are different from ours in that her areas originally were untimbered, and the planting operations will be on the afforestation plans, and mostly by the state, as the private ownership of timbered lands constitutes such a small fraction of the area in wood.

Her rabbit pest is a serious drawback and her white ants also; we do not understand that the latter prey on the exotic trees as they do on the natives. If we are correct in this conclusion there should be a greater incentive for planting our pines. The only objection offered to them is that they are knotty, which can be easily overcome by early and annual pruning, and in the new plantations the danger of fires (which fill the pages of those reports as they do those of our own) will be overcome at the same time, and as the new planting will be largely on cleared soil, the question of cultivation and the increased growth therefrom will make the intensive system the more economical one for them to pursue.

We think the cottonwood tree would be a great addition to their artificial plantings, as packing case material can be had so near at hand in such a short time, and while paper making has not made much progress there yet it will only be a question of a short time when it will be a home made product. From the beautiful illustrations accompanying these reports or statements, it would appear that if the intensive methods of culture and pruning were practiced the result should be simply astounding. There must be some mineral element of plant food in the Antipodes conducive to the growth of foreign trees that does not bring along the native trees as well. It would also appear from these reports that our stock of rapid growing trees could be greatly augmented by a study of some of their quick growing soft woods.

Annual Progress Report of the *State Forest Administration in South Australia* for the year 1918–1919.

Page 5: "Of 392,860 trees planted in eight planting operations 90¼% lives." "Because of scarcity of labor and the requirements of the wheat scheme (new sheds to store surplus wheat) planting at Warrabora was postponed." "Thinning operations among the saplings have received careful attention, three blocks of 294 acres (after thinning) averaged 204,179 and 289 trees per acre of Eucalyptus." "Good work also has been done in pruning and thinning at Cava Range, etc." "It is worthy of note since the first start was made to demonstrate the value of the remarkable pine (*Pinus insignis*) since 1903, 850,961 fruit cases were sold; the gross return was $170,000."

Page 6: "Illustration No. 10 shows comparative growth of remarkable pine (*Pinus insignis*), the Maratima pine (*Pinus maritima*), Weymouth (white) pine (*Pinus stebus*) and the Corsican pine in the order named greatly in favor of the first named one." "During the last 37 years nearly ten million trees have been given away to over fifty thousand recipients." "Nursery stock on hand June 30, 1919, 1,283,000 trees."

Page 8: "Of the 170,000 remarkable pine 161,000 are alive." Much interesting detail is given especially as to the cost of the various operations.

"In the report of the *Forest Service of Queensland* for the year 1919–1920, page 5, with limited stock of timber on hand and the responsibility of not only making immediate provision for to-day but of making immediate provisions for the needs of three generations ahead the pivot of forestry is silviculture." "Effective silviculture depends primarily on efficient utilization of original crops." "To bridge the gap between the old and the new forest is a matter that calls for a consideration." "The production by the forester of a sixty-foot tall stand of trees on Frazier's Island in five years gives assurance that supplies of raw material for wood pulping will not be lacking, when the industry is established."

"The Hoop pine already has been determined of high value for the production of Kraft paper." "The Eucalyptus gives 70 per cent of tannic acid." "Despite the warnings public opinion failed to sense the danger of forest neglect." "An artificial price depression due to the wholesale dumping of the surplus products of the American saw mills engaged in a cut throat competition with the cheap labor of Russia and Japan."

"Thus while to the seeing eyes a timber famine was perceptible, Australia was busily engaged in squandering its limited heritage of woodland supplies, because the fierce competition abroad had temporarily made the profitable practice of forestry impossible." "Thus Queensland found itself with less than one per cent of its territorial area in timber reserves when the war began." "Notwithstanding the difficulties under which the work of the Forest Service has been performed, forestry has emerged with substantial achievement as a function of the government, as each of the operations have returned revenues in cost twofold."

"The Hoop pine district yielded 87% of the revenues."

Costs of establishing forest operations are given in great detail, which throws light on the disadvantages under which our kinsmen of the Antipodes labor in an almost treeless region. Among other things we notice in these reports is the necessity of providing pasturage for the oxen engaged in the work, otherwise, "when the roads are good the oxen are too poor to work and when the oxen are fat the roads are too muddy to work."

Page 9: "Twenty acres cleared and burnt, sown with Rhoades grass (during this operation 55,000 board feet of timber was sold from this paddock), at a cost of 76 pounds (or about $350, equal to $17.50 per acre). Two hundred forty acres of useless timber ring barked (or girded), 20 chains of wire fence and 20 feet well sunk for 90 pounds (equal to $450, less than $2.00 per acre.")

We dwell upon these apparently unimportant details to show by comparison how cheaply they overcame their natural handicaps, in an arid, treeless country and the success that has crowned their efforts.

Page 24: "It was intended to plant large quantities of Hoop and Bunya pines, owing to adverse weather conditions the original project had to be abandoned. Some plats were planted showing 20 to 60% success. Of the exotic pines (*Pinus taeda*) American loblolly was 60% successful." "Hoop and Bunya pines show 60% of success after three years, had seasons the former with a height growth of 14 feet, the latter 8 feet 6 inches, *Pinus taeda*, 5 feet 9 inches (Loblolly)." "Should overseas freights fall dumping of foreign woods at Australian ports will follow." "Forest utilization is largely a price problem, high prices produce the pitch of perfection in utilization, 20,000,000 feet of knotty pine logs previously left in the woods to rot are now finding a market."

Page 4: "It is axiomatic that the market value of logs fixes the radius of haulage."

Page 47. "In many 40 acres of hardwood forests as an experimental operation in assisting natural regeneration of first class hardwood, the exclusion of tree weeds cost about $35." (Less than 90 cents per A.) "Trees which were planted a few years ago by the tube or bamboo method are now fine." "Four acres were cylinder planted 6 x 6 (at $16 per acre); although the season was exceptionally dry practically all of the young trees lived."

Page 48. "*Pinus taeda* (loblolly) planted July, 1915, present height (June, 1919) 16 feet, Hoop pine, August, 1914, June, 1919, 8 feet 9 inches, Bunya pine, planted 1914 (June, 1919) 9 feet 8inches, kanri pine planted in 1916 averages (1919) 15 feet 3 inches high, withstood drought and frost."

Page 53: "British Empire Conference held in London in July, 1920, after seven days meeting, on the 22d passed resolutions covering a forestry policy, first (in part) each of the governments of the Empire should lay down a definite forest policy, etc. (we skip) (2, 3, 4 & 5) to 6." "The advantages which have accrued in several parts of the Empire from the wide distribution of forest plants, etc." "We skip over to the eleventh and last resolution." "The conference is convinced that the holding of conferences of the representatives of the Empire on forestry matters is of great service. We desire to thank the Forestry Commission of the United Kingdom for causing the Conference to be assembled, and for making the necessary arrangements."

Page 54: "They recommend that the next conference be held in 1923 and that if the Dominion Government approves it be convened in Canada."

Page 56: "We desire here to record the fact that, in our opinion, forestry research has not received recognition from non-official sources, and we venture to draw the attention of organizations and individuals interested in the subject to the wide scope which exists for liberality in the financial support of these branches of research, which are of vital importance to the well being of the Empire."

I have dwelt on these far away reports only because the subject was brought home to every civilized nation from natural causes hastened by the wanton waste of war that makes it a universal one. Their problems are our problems, but nature has been more bountiful to us in a responsive soil and a generous rainfall than to the Australians without the rabbits, big and little kangaroos, the white ants and other insect pests of our friends on the other side of Mother Earth; I present these problems not only to emphasize the crying need of the day, but that we may profit by their experiences.

It is generally claimed by the text books that the selection of species for artificial planting should be confined to their usual habitat, a theory completely disproved by the quotations from these reports, especially as to the conifers, notably the American loblolly (*Pinus taeda*); there it thrives 12,000 miles away, where planting was a necessity long before we began to realize the seriousness of our supply of woodgoods.

A better reason why loblolly has been restricted to its natural home along our sea coast is first, birds do not carry its seed. In that section of our country where white pine naturally grows the question of artificial planting has not been seriously considered, or preparations made to meet the demand, especially as to nursery stock of forest trees, and they take to the reproduction of white pine most naturally, for there is no all purpose wood more useful when fully matured, the kind the people of that section still remember. But to plant white pine—the unborn generation cannot live to see plantings mature except by artificial, annual pruning. As to its immature wood it has no advantage over loblolly, and for many purposes is much inferior. It is not only of much slower growth, but when left to nature much slower in shedding its limbs than loblolly pine. Otherwise there would be no need of the mixture, except for the mutual helpfulness, and the prevention against "too many eggs in one basket."

It is for that reason that we seize on to everything that helps to prove the enlarged field when this most valuable wood (next only to white pine in usefulness) may profitably be grown. The trade name by which it is so widely known covers many kinds of short leaf pines which are known to be slow growers, and producing only low grades of lumber it makes the differentiation of those varieties from this most superior wood a matter of vital importance in determining what selection of forest trees we must decide on to make forest planting a more useful and profitable enterprise. Not that the products of those inferior kinds of pines, grade for grade, are of less value than the loblolly, but in nature there is nothing but low grade lumber in most of those kinds, hence of small value.

To the outside world a tree is of value for its shade or appearances, but to that part of it that makes lumber a business it is quite another matter, it is to the trade more what is on the inside of the tree than what appears on the outside. On the question of the natural habitat of trees, I am sure our Forest Service could perform no service more useful than the study of Australian trees, with extensive experimentation with their seeds in our nurseries. The importance of that subject I saw many years ago on the London, Liverpool and Hamburg docks where were wood-goods from India, Burma, Java, Japan and the wonderful kauri pine from Australia, to say nothing of the woods from the Baltic, the Black and White Seas, the United States and Canada.

The same log cut in Africa was sold at auction in London, reshipped to Hamburg and finally landed in Grand Rapids, U.S.A. It might be easier to transport the seed than the tree, and let time do the rest. But all that has nothing to do with our immediate wants, which may be promptly met by the American farmer if he is properly advised. Yet it is not unlikely that a mahogany tree can be propagated and grown in the South end of the Gulf States.

We also take issue with the theory urged almost unanimously by the reports of the State Foresters (of which we made no mention in our quotations, for the reason that we were dealing with a method or system rather than a species) that "the natural habitat of the Carolina poplar or cotton wood is along river bottoms." But as that wood is such an important factor in our mixture, we must say we have never yet seen a situation unsuited to the growth of the Carolina poplar, which leads us to believe that there might be a difference between it and the cottonwood?

The Department of the Interior of Western Canada, Bulletin No. 1—reports on tree planting on the Prairies of Manitoba, Saskatchewan and Alberta.

Page 7: "Although certain portions of Western Canada are naturally timbered, the larger portion of the settled areas are treeless." "But it is generally thought that a large part of what is now prairie was not originally so. Undoubtedly the chief cause was the frequency of prairie fires." "The fact remains that there are immense tracts of land absolutely treeless, which can only be utilized to their fullest advantage by the protection afforded by belts or plantations of trees. The advantages of tree growth in affording protection to ordinary field crops are noticeable."

Page 7: "They add greatly to the value of the farm."

Page 8: "Three points are important for success, first, the ground must be thoroughly prepared, second, only such species as are known to be suitable, third, a certain amount of cultivation is absolutely necessary, until the tree is well established." "It would be absolutely foolish to plant trees and expect them to live under ordinary circumstances." "It is more difficult to raise trees here where the rainfall is limited than in the Eastern provinces."

Page 10: "In the prairie provinces the supply of moisture is extremely limited, and what little there is must be kept there as long as possible; that can be done by keeping the soil loose and friable by cultivation, as then evaporation of soil moisture is at the minimum; as soon as the surface becomes hard and baked evaporation is very rapid."

Page 11: "What the trees want most is a good supply of water, thorough cultivation is the only way to bring about that condition."

Page 14: "Mixed plantations suffer less from insects and fungus attacks, a mixture of rapid and slow growers will in most cases give a larger continuous return per acre and per year than if made up with a single species. Nursery raised plants will prove more satisfactory than those grown naturally. The only time to plant in the West is in the spring."

Page 16: "For a windbreak, such trees as Manitoba Maple, cottonwood or Russian poplar 4 x 4 is the best distance; after 5 or 6 years many of the poplars would be large enough for fuel and could be cut out."

Page 20: "The rainfall in the prairie districts is so small that every means should be taken to preserve what little moisture there is; surface cultivation is the best method of accomplishing this, as it keeps the soil loose and acts as a mulch. After a heavy rain the cultivation prevents the formation of a crust; in all cases cultivation should always cease before the end of August, as new wood might be cut back by early frost."

Western Canada maintains a complete and extensive nursery of 480 acres at Indian Head and 320 acres at Sunderland, also Eastern Canada maintains forest tree nurseries at Ontario and Quebec for those desiring to plant within those provinces. Broad leaved trees are furnished farmers at no cost except expressage, the number to each applicant is limited.

Page 27: "At Indian Head the average is 831 trees per hand including the teamster who plows the furrow; they were one and two-year old seedlings or small transplants; the Conifers require more cultivation."

Page 29. "Table of growth show Russian poplar at ten years (from seedlings) to average 35 feet high, and paper birch 17 feet. Green ash measured in 1881, 2½ inches, in 1901, 12 inches." "Cottonwood is a hardy and rapid growing tree, generally speaking the Russian poplar will prove more satisfactory than the cottonwood." "The seedlings are usually two to three years old after the first year. Growth varies from two to five feet. During the first and second Winter the young shoots are frequently cut back by frost. This does not appear to impair the vigor of the young plant."

If in that country of limited rainfall as well as in the limited areas of Australia, where moisture is so much at a premium, they have had such success as their reports indicate, we of our more favored clime, should not hesitate, while cottonwood thrives so far North, yet it is not reasonable to expect the same rapid growth there as we should have here with all of our advantages of moisture and longer growing seasons. Their reports encourage the opinion that our loblolly pine would thrive there as well as the cottonwood. Even though the young shoots might be occasionally nipped by an extra early frost, that would not necessarily interfere with the growth of bole to any appreciable extent.

Some photos show remarkable growth with their intensive system, which they are compelled to practice but only to a certain extent; so far they appear to have no experience with artificial early pruning, but they are far removed from a market for thinnings of woodgoods, except for firewood. The progress they are making in their nurseries and their experiments now going on for more than 15 years, the general movement in all the British colonies, give an earnest of what may be expected from them in the near future. An elaborate report of the Crown land department of New Brunswick for 1920 is more statistical of existing forest than anything else, except the lament of the havoc caused by forest fires.

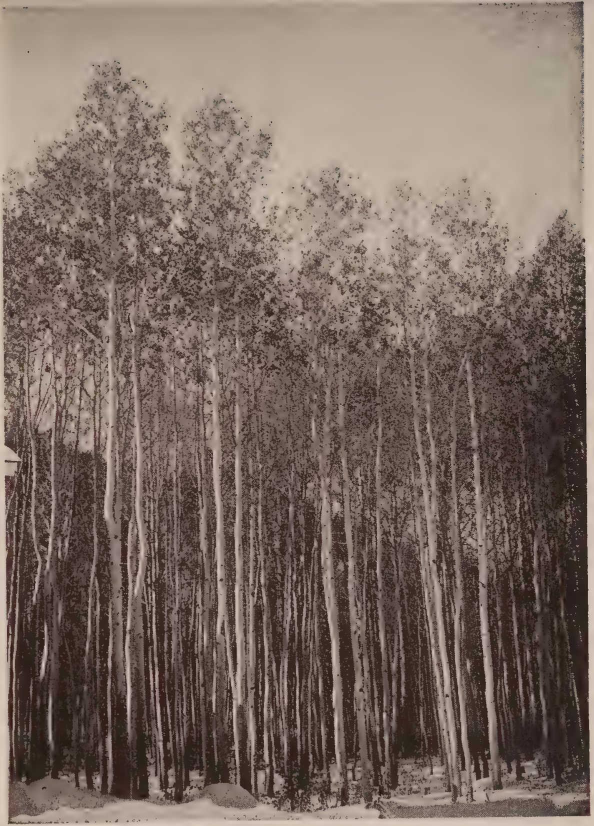

Photo by Courtesy U. S. Forest Service

Forty-five year old stand of Aspen, Manti National Forest, Utah.

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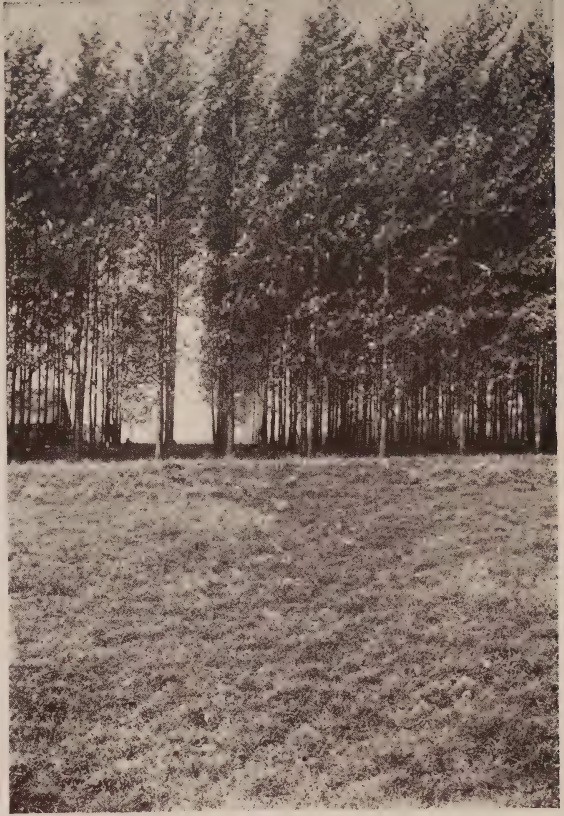

Photo by Courtesy U. S. Forest Service

Fine grove of Cottonwoods 10 years old, Elmore, Minn. Boles unusually straight and clear.

They like the timbered states of the far South have no present reforestation problems, especially as to artificial planting. They all are yet more interested in reducing acreage in timber to make room for tillage and more people, than any movement in that line except by nature's plans. That, of course, can be greatly helped by wise legislation. We have carried our readers from the borderlands of the Arctic to the Antarctic zones, and from Japan back to the Western shores of, last but not least, the land of our United States.

Our claims are approved by the foregoing quotations, if not as a whole in any one report but fully when considered point by point, in the sum total of the wonderful mass of information gathered here. It is a matter of pride and pleasure to find my experience is strictly in accord with the best teachings of the professions, when discussing maximum results regardless of costs, supply and demand, which, of course, become questions that did not exist even a few years ago; therefore what might have been heresy then is orthodox to-day. It is only fair to say that results under my claims reduced to dollars will be ridiculous unless they are practiced in the fullest measure of intensity.

CHAPTER XXIV

United States Bulletins 1123 and 153, Cottonwood Bulletin 24

United States. Report of the Department of Agriculture for 1921. Bulletin 1123.

Page 5: "A mixture of two or more kinds of trees in a plantation may sometimes be desirable." "Planting stock of any kind alone may be expensive, and if a less valuable tree, or filler, to be cut out when the trees begin to crowd, is mixed with the main crop, it will keep down the first cost." "Preparation is decidedly beneficial although not always necessary." "If the soil is heavy or rocky, or if the trees have large root systems, the best method is simply to dig a hole for each individual tree, pull the soil over the roots and tamp it thoroughly."

Page 10: "Early spring planting is generally preferable." "Trees which grow well in the shade such as hard maple and beech, may be planted more closely than those that require abundant light, such as cottonwood and yellow poplar." "In regions of little rainfall there will not be sufficient moisture to support a dense growth of trees."

Page 12. Table IV: "Spacing for yellow poplar and cottonwood 10′ x 10′, all others 6′ x 6′." "Cultivation is nearly always beneficial to a plantation, especially so during the first several years of its existence." "Cultivation is essential to success, in regions of little rainfall, and on areas heavily sodded with grass." "A heavy sod practically insures the failure of a plantation." "Horse cultivation is entirely practicable. Cultivation should be given two or three times a year."

"There should be no cultivation after the middle of the growing season." "To produce clean bodied timber close spacing is desirable, when they crowd each other, they become like an overcrowded stand of vegetables in the garden, growth is stagnated." "When trees reach a similar condition some of them should be cut out, the result is the best development of the remaining portion rather than a poor development of the original number."

Page 15: "If because of wide spacing the trees are assuming a poor timber form it may be necessary to correct that condition by pruning."

Page 22: "It is often no cheaper to grow seedlings than to buy them." "Seed beds should be located in well drained soil, in proximity with the farm dwelling, because rodents are less likely to be there." "Thorough preparation will result in a better growth of seedlings."

Page 14, Fig. 8: "Illustration of cottonwood trees, 8″ in diameter, 50′ high, 12 years old," without cultivation, thinning or pruning.

The United States Bulletin No. 153 of the Department of Agriculture for 1915 is of interest to landowners throughout the northeastern portion of the United States from the Ocean to the Lakes, the section studied."

"The census of 1910 shows the average size of the farm is 138 acres of which 75 are recorded as clear, and 63 as unimproved." "The woodland and other unimproved lands covers a total of over 400 million acres." "In New England since 1870 the farm land improved has declined from 61.3% to 36.8% in 1910."

"Most of the unimproved land in the East and middle West is better suited for growing timber."

Last census shows New England has lost 32,000 farms and more than one million acres of woodland and other unimproved land since 1910.

"Conditions in this region are particularly favorable for fire protection, intensive management and maximum yield." "Timber brings the highest price, when the natural supply is becoming scarce." "In 1890 the average price of saw logs in the United States was $6.28." "In Iowa, Indiana and Ohio it was $12.16, $9.39 and $9.47 respectively." "At one time four fifths of the area of Indiana was covered with valuable forests."

"In 1890, 82% of the lumber used in that state came from the outside." "The price of fence posts has doubled in the last twenty years." "The consumption of cord wood in the United States to-day is about eighty-six million cords, at prices ranging from $4.00 to $7.00 per cord. The latter price in cities over 30,000 population." "In Massachusetts a plantation of pines twenty years old from 6 to 8 inches in diameter. In Rhode Island a plantation of hard wood on forty acres after fifty-seven years showed 6.92% of the capital invested." "Of the 10 million acres of abandoned farms, large areas lie within the New England States. On most of these lands natural reforestation is slow, except in the case of inferior species." "White pine is the tree being planted most in New England. It is subject to serious damage from the white pine weavel, and for that reason some other species may to some extent take its place in future planting." "Forest planting as a commercial enterprise is being more widely agitated in New England to-day than any other part of the United States."

NURSERY STOCK.

Page 6: "With coniferous trees, two-year-old seedlings or transplants or three-year-old transplants are best." "Transplants should always be used on heavy soils where cultivation is impossible or when the young trees must compete with a heavy growth of grass, or on cut-over areas filled with roots of old trees." "A tree's height-growth during the first year usually indicates its future vitality." "Thus the taller trees should be given the preference in planting. In a planting of 7 feet trees and 3 feet trees from the same nursery rows were planted separately in similar sites, after 4 years the 7 foot trees were 20 feet tall, and the three foot trees had grown only 12 feet in the same time."

"Advantage could be taken of this characteristic by planting the more or less vigorous trees in mixtures, the shorter ones as fillers to be cut out when the stand becomes crowded, the taller ones to be left until maturity."

Our system needs no such fillers so we should condemn the shorter or weaker trees; nothing could be more extravagant than the so-called economy of first cost plants, or planting. We obviate the necessity of fillers by annual pruning, and only plant what will grow to a commercial tree, and not the extra hundreds or thousands of trees per acre, to be wasted either before or after they have performed the duty of prunning themselves and their survivors, and they in turn must succumb to their fate in favor of their still more lucky neighbors, long before any commercial size can be had. This process goes on from year to year, a struggle for existence; finally after twenty to forty years, or more, real and clear growth begins with those that are left.

If such methods are necessary, there then can be no commercial planting of forest trees that would appeal to farmers as a business enterprise. But it is our business to prove that our way is the cheap way and the paying way, and paying its own way, that early pruning is not only beneficial, but economical. The old way is expensive, extravagantly so, and inefficient, by comparison.

Page 7: "If the trees are received in poor condition, or if they happen to have a poor root system, it may be necessary to plant them with particular care." (Again in the above case we should condemn all such plants, as we could not afford to have our careful preparation and our practice of intensive methods wasted at the start by the use of defective plants, even if it should save a few dollars of first costs. Time with us is money, and interest is the greatest expense in tree growing.)

Page 8: "Individual hole method which has not been used extensively consists of digging a hole for each individual tree. It is undoubtedly the surest method, at the same time the most expensive." (Here again we take issue with the idea that the individual hole method is the more expensive. The previous page was devoted to the so-called inexpensive way, the same as has already been described in the reports of the several Foresters quoted.)

There can be no question that it costs less to make a hole with one stroke of a grubbing hoe than to dig one with a spade and shovel (and we go a good way further and dig deep, and replace the bottom soil with surface soil, to accomplish the object sought, that is an early harvest from the planting). We have every proof from these quotations alone that the "surest way is the best way," and the best way is the cheapest in first cost and in the long run. We might, however, take issue, even if the low cost way is the cheapest first cost, that is, we claim we can prepare 720 holes properly and plant carefully, and pay the cost of the fertilizer, at less first cost than by the old method of planting one or two thousand trees per acre, by any method, no matter how swiftly, carelessly or cheaply the work may be done.

For the same reason we would discard plants that do not come in good condition, even at the expense of losing the price already paid, yet we think the danger of getting plants in poor condition is remote, as with fast motor trucks it is only a question of a very few minutes or hours from the nursery to the nursery rows, or with the seedlings planted for future transplants, it should only be a few minutes from the transplant rows to the final location. This bulletin from which we are quoting is of 1915, and something has happened to the world's domestic economy since that time.

We are not searching these reports for anything but the truth, we do not say they were false in the light of the days they were written, and even then while the general tone is that the method they approve will not pay, they have not taken the trouble to investigate any other method. Yet there is ample proof in their admissions that there is a better way.

We have found much of interest in them, but we are dealing with but the one phase, that is, the modern methods of commercial forest tree planting that will pay their own way under the intensive system of culture and care. Ours simply is the art of forest tree handling and reproduction on cut-over ground and the improvement of natural stands of young trees of commercial kinds.

Page 11: "Plowing and harrowing the planting site before setting out the trees is a wise practice." "It puts the soil in good tilth, facilitates planting, conserves soil moisture, increases the proportion of successful trees, and induces rapid initial growth."

That paragraph would sound all right even in 1922, and if we claimed any patent or copyright on that part of our method, it would not hold good. We claim only what every thinking farmer knows, and has known all along, that when there is a general demand for the product of the soil, it can only be produced profitably by best methods. Slipshod methods will not pay in anything, but might be more excusable in experimenting with a crop that comes and goes in a year, rather than one that requires a decade or more.

Page 12: "White pine is so tolerant that it must be planted 4 x 4 feet, in order to have the lower limbs killed off at an early age." "Close spacing requires a thinning before the stand is twenty years old, and with some intolerant and rapid growing trees, such as cottonwood, by the time it is ten years old." "The trees removed in the early thinnings required by close spacing would usually be unmerchantable, hence a wider spacing is generally best. Wide spacing reduces the initial costs, and will yield larger trees than can be grown in same time in a closely spaced plantation, in which early thinnings are not made."

CULTIVATION

Page 13: "Most forest plantations should be cultivated two or three years after being set out. They become well established during the first and second season, and grow vigorously in height during that time." "Forest trees, like fruit trees, are subject to damage by early frosts." "Late cultivation is conducive to succulency so no work of that kind should be continued after the middle of July."

Page 14: "Some planters have found two cultivations a year sufficient." "A three-year period should be ample, with possibly three or four cultivations during each of the two first seasons." "The principle of thinning is the same as the truck gardener applies to his crops, in order to get the best development of a portion of the crop rather than a meagre development of the whole." "The struggle for existence between the trees of a thick stand first induces rapid height growth, and kills the lower branches, but, if allowed to continue, the more vigorous trees are prevented from making their best diameter growth by the presence of the less vigorous ones." "In the more widely spaced plantations, thinnings are not necessary until the product is of merchantable size." "The future, however, promises a better market for the small-sized material than exists to-day (1914)."

Page 15: "The dead and dying trees form a very close crown cover, or an apparent stagnation of the living trees indicate a thinning is needed." "The first thinning may be needed before the stand is ten years old." "Inferior trees may serve the useful purpose of shading the soil, this tends to retard evaporation, or prevent the growth of harmful vegetation."

Page 16: "Cottonwood and European Larch die from no apparent cause, except insufficient light. For white pine the openings need not be large." "There are no instances in this country where thinnings have been systematically carried on, and for that reason it is not possible to cite examples of their effect."

Page 16, Table 2: Indicates decided advantage in wide spacing for diameter growth for Larch, White Pine and Cottonwood. Details take up too much space. This Bulletin, number 153, can be had of the Department of Agriculture for the asking.

PRUNING.

"The purpose of pruning is to protect the trees' form, to increase the growth and to improve the quality of the lumber by getting rid of the knots."

Page 17: "Especially valuable species and trees of very persistent branches should be pruned. White Pine and Black Walnut sometimes need pruning." "The lower branches of White Pine persist for many years after dying. In order to increase the development and control the tree's form an effective and cheap way is *to pinch off the shoots* just as they are developing from the bud." "Where trees are widely spaced the tendency is to fork; such trees should be pruned of all but one of their leaders."

Page 18: "Ash will grow fairly straight if spaced closely and pruning should accomplish the same results."

"One method of pruning is to pinch off the lateral buds formed near the tip on the terminal shoot."

"A mixture will more completely utilize the area planted, and bring about a better forest condition in the plantation."

Page 19: "If the grass around the trees is killed by cultivation there will be less danger from mice."

Page 23. "Timber products will most certainly advance in value."

"Common cottonwood is the most rapidly growing tree commonly planted; when thirty to forty years old, the trees begin to die at the top. For its best development a wide spacing is required, for it thrives on sunlight; close spacing not only adds to the first cost but results in the death of many trees before they are large enough to be of much value."

Page 24: "Cottonwood has done well in Iowa, and probably would thrive throughout the whole Eastern region, even to the New England States."

"White Pine is not exacting as to soil but requires good drainage. In practice spacing 6 x 8 to 8 x 8 feet is usually close enough."

Table 7:	Space	Diameter	Height	Product
at 20 years old	11 x 14	8.7	39′	215
" 37 " "	8 x 9	9.7	50′	540

We have dwelt on that paper as we have on none of the others, because it covered the whole field more fully than any one of the others and while the writer of that bulletin is loyal to the guild, to the orthodoxy of American Forestry, he knows what practical tree planting and culture by the intensive methods means and is, and a careful reading will show he has not far to go to be a complete convert to the modern methods of the intensive system of artificial tree planting, pruning, culture and cropping when considered in the light of present-day values.

We undertook to prove by the authorities quoted that our practice will yield the results claimed. That is, that the proper and economical handling of the wood now at "Lotuswood" would produce the yield mentioned and that the prices named in our estimates are well within the present market prices, the cost of marketing the woodgoods as stated is reasonable, and the net proceeds are well within reason.

That before the end of the ten-year period allotted for the removal of the woodgoods now standing, there is more prospect for an increase than a fall in prices. That the cost of preparation of the clean-cut and low-stumped land, the cost of transplants, the planting, fertilizing, liming, inoculation, cultivating and annual artificial pruning, and harvesting, and thinning is a liberal one based on present high wages; and that the new crop of cottonwood will be ready for the market, either as pulp wood, veneers, laths or crating slats before the end of the ten-year period allowed for the handling and removal of the last of the woodgoods to be clean-cut now standing at "Lotuswood." And before the end of its rotation a high grade of lumber will be ready for market.

United States Department of Agriculture, Bulletin No. 24, 1913.

Page 1: "Cottonwood is one of the important timber trees native to this country. It is a tree of very rapid growth. Twenty years is sufficient to produce timber of fair dimensions. Cottonwood's importance as a tree for artificial forestation is attested by the fact that it has claimed the attention of France, Belgium, Germany and Argentina. Near Buenos Aires a lucrative industry has sprung up, yielding as high as 15%; boards but 3 to 4 inches wide and 6 feet long find a ready market at high prices."

"In this country growing cottonwood commercially has not received the attention it deserves."

Page 3: "The wood though relatively not strong, is strong in proportion to its weight; when seasoned the wood is almost tasteless and odorless. In the manufacture of shipping cases for food products it is used in large quantities; when taken weight for weight the cottonwood box outclasses in strength practically all other species."

Page 5: "Cottonwood has been used for some time in the manufacture of pulp, almost identical in character with that from the aspen." "It also has been considerably used for excelsior, for which it is highly prized."

Page 13: "Compared with pine or spruce, cottonwood of the same age has fewer trees per acre. Thus at 35 years when the trees average 20 inches breast high an acre will have only 50 to 75 trees."

Page 19: "Pure stands of cottonwood are extremely dense. They undergo very rapid thinning with age. It is not unusual to find two-year-old thickets with probably 40,000 living trees to the acre, but thousands of the young plants die soon after germinating." "At the age of ten years there are seldom more than 700 or 800 trees left and at 25 years this number is reduced to about 120 trees per acre."

Page 22: The maximum height recorded by the Forest Service is 190 feet. Diameters of four to six feet are not unusual. Stand of average density prunes itself well, producing long, clear boles for a distance of sixty to eighty feet with comparatively little taper." "It is a tree of remarkably fast growth especially in early life. Trees have been measured that were eighty-three feet tall at twelve years and one hundred feet at fifteen years."

Page 24, Table 3: "Number of trees per acre at seven years old is shown to be 1450, with an average diameter of 3½ inches and 36 feet tall; at 14 years, 320 trees averaging

8½ inches and 76 feet tall, when there were 150 trees more than 14 inches in diameter. At 21 years there were 150 trees with an average diameter of 12.8 inches, 45 of which were over 14 inches in diameter, and 97 feet high. At 28 years there were only 98 trees left 16½ inches (only 37 of which were less than 14 inches) and 112 feet high. At 35 years there were left 59 trees averaging 19.7 inches in diameter breast high of which only 6 were less than 14 inches."

While we need no such rapid growth to demonstrate our system, it is beyond argument that given an original stand equal to the soil's capacity to produce 726 trees per acre and had the cutting for market begun at 7 years, at the rate of 35 trees per acre each year, the yield from the intermediate cuttings would be equal to the 150 trees remaining at the 21-year period, at which time there was 7,600 feet Scribner per acre, without counting the advantage of proper preparation, planting, cultivation and annual pruning, and regular crop thinnings. Trees of that size by Scribner do not yield according to log measure like they do either in sawed lumber or in cubical contents, or as measured by the cord, as will be later shown by the same Bulletin.

Page 25, Table 4: "Shows at 7 years the yield was 10.7 cords, at 14 years, 49.4 cords, at 21 years, 52 cords; a gain of only 3 cords in the last 7 years. It shows conclusively that it is a crop tree and not for a permanent forest, just a good filler, while waiting to give the loblolly the next chance for 15 years, and then the white pines."

"Planting insures a uniformly stocked stand. The spacing of the trees can be so regulated as to obtain more rapid growth during early life, and there is less chance of failure due to weeds and undergrowth."

Page 37: "The cost of deadening, swamping, piling, and burning the smaller growth can usually be kept under $2.50 per acre. If the ground is dragged to expose the mineral soil, piling would be advantageous."

Page 39: "Thinnings if properly done at the right time will result in accelerating the growth of the trees left, and at the same time utilize the small trees that otherwise die from suppression. Cottonwood, in the course of natural development, the average number of trees per acre falls from 700 to 50, from 10 to 40 years. There must be a great loss in growth due to competition."

Page 50: "On freshly cut-over lands planting without thorough preparation is inadvisable, higher stumpage values warrant intensive preparation." "Artificial reproduction is but little more costly than natural, and since under it results are much more certain, it may often be advisable to employ it exclusively."

When it is remembered that the bulletin from which the foregoing "quotations" are made was written four years before we entered the war, and in the light of what has happened since and the present conditions relating to timber supplies, the author, if called on to revise it, would have a very short step to make before he discards seed trees, natural seeding, thick stands and gets right over to modern methods, of the new system, sensible spacing, proper preparation, nursery transplants, careful planting, fertilizing, liming, inoculation, cultivation, annual pruning and commercial thinning—in short, the new system of intensive culture and care of the woodlot for profit.

Measurements taken by the author of Carolina poplar on a nearby farm on high and dry land away from any river bottom:

12 years old 52 inches at the stump—outside of the bark.
22 " " 84 " " " "
32 " " 100 " " " "

CHAPTER XXV

A Summing Up of the Quotations from the Reports. Cost of Seed Prohibitive for Artificial Seeding. Cost of Thick Stand Prohibitive for Artificial lanting

WE will proceed to sum up the findings of the records of the several states, a veritable mine of information on the subject. Through them we have diligently searched for the last word on reproduction; in our quotations therefrom, on the subject of commercial forest trees, their planting, care and growth, we feel that we have concentrated in a few pages in this book information of intense universal interest, more that is available to the student of forestry than can probably be found in any one work extant.

We cannot undertake to comment on the various views we find in those reports, except in a general way, for the purpose of emphasizing the degree of unanimity with which they all dwell on certain methods, so long accepted to be orthodox. We realize how hard it is to give up ideas inculcated by years of study of accepted doctrines no matter how certain the outside world may already know that such antiquated theories must give way to well known facts.

It is much easier for the layman to accept new ideas, innovations on accepted theories from the lessons taught by time and experience, than can the scientists, the experts, the trained student of a profession with a lifetime devoted to a practice that has served its purpose. The point can be elucidated by the remarks of an Admiral, a trained student of naval affairs and long an instructor of that science, uttered from the deck of the ship from which he witnessed the destruction of a huge warship, S.S. the *Ostfriesland*, one that successfully passed through the great Battle of Jutland in the North Sea, by two bombs, both of which fell in the water nearby, of a ton each dropped from airplanes that were not dreamed of when he took his first lesson in the art of naval warfare. In a few minutes the great ship had sunk from sight forever.

He is quoted as saying, "I know not whether to be glad or sorry—sorry because I must begin all over again, or glad that it may make war so dreadful, etc."

When the Wrights were practising their first flights from one sand dune to another at Kitty Hawk, scarcely twenty years ago, little could they have dreamed of the airship's far-reaching uses in so short a time. The scientists must work from the viewpoint of to-day and to-morrow rather than of yesterday, except from the lessons it taught.

We find there is a universal opinion as to the necessity of a movement to meet the demand now here and still coming, for a supply of forest products, with page after page of natural seeding from mother trees, from sowing by hand on prepared and unprepared soil, old fields, and clear-cut woodlands, from spot seed planting, and from artificial planting of seedlings and of transplants. But not a word of experience of intensive methods of culture or of annual pruning embodied in one workable system as a whole.

We are very properly told that natural seedlings are too slow and uncertain. They know the mother seed trees do not exist on the cut-over grounds, or on the ordinary woodlot, except in rare cases in cut-over regions. They are told sowing seed on unprepared soil is utterly useless, and on prepared soil uncertain, and if a partial stand is secured, it is likely to be overrun with weeds, briars, vines, grass, suckers and weed-woods before becoming established. We are told spot-seeding has too many enemies in rodents, rabbits and birds to offer any hope of success. In fact, after dwelling long on those various methods of reproduction they are forced to admit that seeding either spot or broadcast was never a practical proposition for private enterprise.

One of the very good reasons was that even in those days of low prices of woodgoods with the seed (five pounds to the acre) at $2.25 per pound that proposition was too expensive as well as uncertain. Therefore, we will eliminate that feature of reproduction from these pages hereafter as we surely are not interested in any plan that is so unanimously admitted to be unprofitable.

In those states where the forests have been practically denuded, all admit artificial planting the only resource for a certainty. Then comes the stumbling-block on which the orthodox fall down, that is, the thick stand for self-pruning. All admit pruning necessary before clear growth begins. Spacings ranging from 4 x 4 to 5 x 6, requiring 1200 to 2800 trees per acre, in order to furnish the necessary crown cover, to shade the ground, for self-pruning and self-thinning, and to create a mulch to keep down the briars and weeds, and to conserve and control moisture.

Those points are dwelt on by practically all of the reports from which these excerpts and quotations are made, at much length, in great detail, and they end by saying that artificial planting is the only sure and proper way, but that it will not pay because of a lack of a market for the by-products. They admit that natural pruning will require all the way from 25 to 45 years according to species to complete the self-shedding of limbs; until then, they admit clear wood cannot be made.

Here we have the views, opinions, experiences, observations, studies and theories of the recognized authorities still clinging to theories and ideas that have completely failed to specifically point the way, to meet the situation we are now facing. There is no complaint for not having heretofore met the obstacles in the paths of those to whom we must look in the great work of reproduction, that is the farmer and private owner of woodland, for the simple reason that when many of those reports were submitted there were already large supplies of woodgoods near at hand and obtainable at very low prices—hence there was no demand for artificial production or reproduction. But as is clearly shown in some of the later reports, and also is well and generally known to the public, the situation now is entirely different. There is a demand at high prices for all forest products, and the need of the hour is how to properly, practically and economically meet the demand.

CHAPTER XXVI

Natural Reproduction is for Timbered Regions, Public Lands and Large Holdings Only. Artificial Planting for the Woodlot

THERE is no complete advice in those official reports, yet there is ample proof that a careful summing up will show that by getting rid of just one of their antiquated theories the others will fall like a row of bricks.

That one point is natural pruning. There are scores of passages in those reports that admit it incidentally. A careful study of those tables will convince the most skeptical that self-pruning is a delusion (the time required with the risk of fire), that it has no place in artificial planting.

With the artificial annual pruning, cultivation is possible and for real and complete success it is absolutely necessary. With cultivation an early harvest is assured. A maximum crop of highgrade lumber should be depended on, and the fire risk completely eliminated.

It is for that purpose that we are giving the public generally and the farmer particularly the benefit of our experiences in handling woodgoods as well as in growing forest trees by the intensive system.

To that end we have carefully perused thousands of pages, scanned many thousands more in our research, that we might secure for our treatise on that system the stamp of official recognition.

In all of those pages there is not one word to indicate that such a system was ever taught or practiced as a complete whole by the service in any state in the Union or by any department of the National Government, Experiment Station, University or College.

Therefore, henceforth, I will treat and term it as the "new system," "our system," or "The Lotuswood system of artificial forest tree planting and growing commercial forest trees" and continue the story rather in contention for the correctness of my practice and for the proof of my claims in pursuing the work as was originally contemplated. Because my system was out of harmony with the accepted views of the profession I undertook the research, the result of which (or that part of it) relating even remotely to the new system is laid before the readers in the preceding pages.

But for my familiarity with all of the questions involved and association with trees in various locations, forms, and conditions, since before the middle of the last century (very few persons are now living with the same experience, leisure and inclination to tell what the world is so eager to know about our vanishing forests and how to restore them), I would hesitate to contend with the experts of a profession of such respectability, that so fully enjoys the confidence of the press and the public.

But their tardiness in realizing the changed condition as to the supply and demand of forest products, and their failure to recognize, appreciate and utilize the potentiality of the farmers and their woodlots to meet the situation, is beyond my comprehension. It is at this point that an explanation is in order as to the "story of Lotuswood."

During the spring of 1920, I purchased the ideal farm and woodland that I have described. It was the inspiration of this work and appeared to be the place to put into practice my intensive system of artificial tree growing, as well as that of intensive farming, and combined to make it the nucleus of an institution to teach college men a few points in practical farming combined with commercial forestry.

In the meantime, I had submitted my advanced views of forest tree growing to a number of professionals. Their replies were so out of line with my experience that I decided at a sacrifice to call the deal off.

It was at this point I took up the work to determine to what extent professionals' experience really differed from mine, with the results shown in the foregoing pages, proving to my mind the soundness of my system as a whole and in every detail, and its absolute soundness as to growing better trees on the farmer's woodlot for profit.

CHAPTER XXVII

Why Nature's Plans Will Not Pay and Why the Lotuswood System Will

THE many points in the old system of other days, of the so-called established laws governing tree growth, that block the way of the farmer with his woodlot to artificial growing of forest trees, for profit, are as follows:

First: The certainty of failure under that system.
Second: The cost of needless transplants for the thick stand.
Third: The slow growth until self-pruned.
Fourth: The long time required before clear growth begins.
Fifth: The low grade of wood produced by natural pruning.
Sixth: The lack of an intermediate crop.
Seventh: The menace from fires, insurance and overhead charges.

The fourteen points that remove the obstacles and pave the way to successful forest tree growing in the 20th Century, under the Lotuswood system:

1. The changed situation in the use and supply of woodgoods.
2. The preservative treatment in inferior woodgoods.
3. The use of so many soft woods for paper making.

Photo by Courtesy U. S. Forest Service

Effect of good soil in an Indiana Black Walnut plantation.

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Photo by Courtesy U. S. Forest Service

Black Walnut plantation, Indiana. Trees spaced.

4. The high price of coal, demand for firewood and improved machinery, good roads and auto trucks to handle it.

5. The average idle woodlot with but little except inferior woods left, should be replaced by commercial trees.

6. The salable inferior wood should more than pay for replanting.

7. The low cost of preparation after clean cutting by the use of power.

8. The woodlot will, if favorably located, meet the cost, often many times over.

9. The low cost of cultivation and pruning compared with overhead cost.

10. The selection by our system of cottonwood and pines, spaced 726 trees to the acre, clean-cut and replanted at the rate of 10% each year. The first crop of pulp wood will be ready on the eleventh year.

11. The crop of cottonwoods will be harvested within 25 years from planting time.

12. The pines will then be all marketed during the following twenty-five years, and leave a permanent forest there more than forty years old.

13. The possibilities of the pruned trees (with the intermediate crop) may exceed $60.00 per acre per year.

14. Annual pruning permits cultivation that hastens the harvest of the intermediate crop, fireproofs the planting, increases the quantity and improves the quality, making the idle woodlot the most profitable part of the farm operation.

These points, pro and con, are fully treated by the quotations from the reports of the forest service, at home and abroad, and by views of my own to meet the changed conditions that we now face.

A careful summing up of the mass of useful information here gathered will convince the most skeptical that a thick stand and self-pruning no longer can meet the demand of the times.

In remote regions where original forests still exist, self-pruning will there still suffice.

The first step in preparation for our system is drainage, the practical handling of the woodgoods now on the woodlot intended for clear-cutting, preparation of the soil and holes and subsequent care. We have stated our practice, our theory, our experience, our contention and our claims and now we submit our findings.

As to the natural reseeding from mother trees, that part is eliminated from our further consideration. In the South Atlantic and Gulf States where considerable virgin forests still remain uncut, it is not too late. When such a large percentage of the area is still in wood, that is the only practice, and if promptly acted on may accomplish a great and good work. But to those nearby the great markets, where the wooded area is largely in the hands of farmers, and in the form of woodlots of various sizes, where largely only inferior and small trees remain, such a practice is out of the question because it is admitted better results must be had quicker than can be attained by such methods.

Those of the older states must deal with the question purely as relates to artificial planting and by the most intensive methods. Without attempting to discuss their views seriatim, we will endeavor to cover the ground in our own way as expeditiously as may be consistent with fairness and truth.

We cannot admit that private planting of any kind can be for any other purpose than for profit. There can be no profit by the first low cost plan; we hold that nothing is cheap in trade if it doesn't pay, and nothing is dear, that does. Therefore to incur the cost of planting a thick stand, and leaving it to nature and the fires is simply extravagant folly; nor can a thin stand without artificial annual pruning or any other kind of a stand be justified unless modern methods be applied in the most intensive form with all that the term implies.

A simple effort to seek the truth in the light of present-day conditions, is our sole purpose. Our system, as we are describing it here, applies only to practical commercial forest tree management and reproduction, by such intensive methods of culture, care and handling, as are justified in the situation as we now see it. A new study of the laws of tree growth, or of growing trees, so far as private planting is concerned, is now the need of the times.

There is very much useful information in those reports, touching many other subjects. But there is a world of matter on this one subject, a synopsis of the whole field of the new system. It is easy to understand, and carries an insight into the general proposition far beyond the reach of the ordinary student. There is much of science, art, and practical experience to be found here on the many divisions of the subject.

Abbreviated as they are, the title page and date will show that the exact language is repeated. All of which is referred to the good judgment and commonsense of the interested reader, especially to those farmers, with woodland, who do not know just what to do with it. In our search for facts and truth nothing of artificial pruning and planting that will give the farmer or owner of woodlots the slightest encouragement is purposely omitted from these pages. We have condensed into one complete whole, a system that meets present-day conditions that will be epochal in the domestic and commercial economy of the civilized world.

We cannot discuss in detail such a variety of views as are set forth in those reports, but will meet those relating to our system. The leading claims outside of self-pruning for the thick stands are the need of humus, the spread of the crowns, the canopy, the needs of the leaves, their source of nourishment, and other technical questions such as how trees grow. We are dealing only with the practical end of a commercial proposition.

We are not fully impressed with their views as to the need of the young and embryo limbs of forest trees for the sake of the fuller crop of leaves and knowing there is a better way to accomplish much that leaves can do, our efforts will be to reduce limb growth to the limit without endangering tree growth. We hold that health and growth are not seriously affected by a clear bole for even 80% of its height, at any stage of its growth after ten years by the gradual removal of the lower limbs.

We have often observed in the Springtime as the bark begins to peel, how fresh cut logs will sink (probably because at that season a larger quantity of the mineral elements from the soil reach the tree through the roots, the trunk and bark, to the limbs and the leaves, than at any other time). At that stage, the timber-getter ceases to put his logs in the water, but continues to fell his trees, but discontinues sawing them into logs, or cutting off the top or limbs so that the elements that cause them to sink are consumed by the leaves; they remain fresh and green for four or five weeks, then begin to wilt. When sufficiently wilted, trees may be sawed into logs and then thrown in the water and they float as well as ever, thus showing that the leaves get their nourishment and water from the soil as well as from the air, in truth much more so.

Another evidence that tree growth is not dependent on the leaves to a greater extent than it is on its roots.

We have no desire to split hairs on theories, or to minimize the usefulness of leaves in tree growth, it is only the limit to which we can go in that direction with a forest tree, so that its growth is increased and the quality of its stem is improved without injury to its health that we wish to consider. We hold the pruning of lower limbs increases the vigor and size of the upper ones, and they thus bear more leaves.

Observe the new growth of leaves on shade trees, when all limbs are cut back to the trunk in order to preserve the symmetry of the tree. Below all branches even after the tree was in full leaf, immediately a new set of leaves put out from the trunk, thus improving the health and form of the tree.

The limit of leaf growth without injury to the tree is what we seek to know for the benefit of the quality of the bole. Nor are we in the least concerned about the loss of humus because of the scarcity of leaves, we overcome all that and more by tilth, that we make possible by early pruning, so that cultivation is made practicable. Leaves are all right in their place, but their place is on the lawn or in the park trees to the limit, but only to the extent of necessity in the commercial forest tree. If we were growing leaves for a commercial crop, we would want the maximum of healthy limb growth. But in the forest we are growing for quality, the straight, tall clear boled tree with as little taper as possible, all of which comes of early and persistent artificial pruning, and the other combined useful helps or agencies of our system, such as good drainage, preparation, fertilizers and cultivation, together with the fireproofing that follows the regular annual pruning and commercial cutting or thinning that pay their own way from the start.

Just what the limit of limb growth or leaf growth is, we do not pretend to know, but are satisfied the importance of excesssive growth is greatly exaggerated. We believe much depends on species (at any rate we will not postpone our planting on that account for that is a part of our system), that can be met when we come to it, by increasing or diminishing as science may prove or experience dictate. Pruning forest trees is a new proposition in this country, an art that our Forestry service admit they have no experience with.

From the beginning to the very end of these documents, especially the official reports, there is a woeful lack of detailed information, recommendations or usable instructions, experience or authentic history relating to the question of profitable reproduction of commercial forest trees. None by intensive methods, practical culture or by annual artificial pruning. Yet all more or less incidentally admit not only the possibilities but the great advantage of the intensive system over the method they recommend. None deny the truth of each and all of the several points of our system, that if followed, will increase the growth and improve the quality of the forest trees, while the easy-going, hit or miss, slipshod plan of yesterday which they claim as their own cannot pay and they offer no substitute that will. If it cost absolutely nothing but the tax and interest on the land it would not be cheap because labor, time, quantity and quality would be wasted. The overhead charge also is costly and quality counts for so much. Maximum crops of best grades must always be the motive of the planter of any crop; where the "game is worth the candle," the two results usually go hand in hand, that is, large crops of any kind can only be attained along with the best quality. A crop of one hundred bushels of corn per acre has no room for nubbins. Forty bushels of wheat has no place for cheat. The successful breeder of live stock has no place for scrubs, the runt or the razor-back.

No point in my many claims for the new system is denied "by them." But the fundamental one is that I say with proper selection of commercial forest trees the artificial intensive system will pay, under present condition of supply and demand.

They say "increment depends on leaf surface hence every pruning reduces increment."

I say every pruning does not necessarily reduce leaf surface, the gradual removal of lower limbs increases the size of the upper ones, and adds to the crop and vigor of leaves.

They say pruning only effects a change of location of increment.

The latter point I agree with entirely, it admits (unintentionally) all that I claim as to pruning.

CHAPTER XXVIII

Cheapness and Thoroughness Combined in the New System. Public Practice All Right for Public Lands, but does not Fit Farmers' Needs

ON a careful analysis of those quotations, strange as it may seem to them, their system is much more expensive even as to first cost, without regard to interest, taxes, or the value of the land. If their holes were made at half the cost of ours, the outlay would be greater because of their greater number, 1200 to 2800 as "quotations" show—on the average say 1500 holes to the acre, as against our 726. In that case, hole making would be more than 100% more costly than ours, if as carefully made, if not, they should not be made at all.

In the matter of transplants at $6.00 per thousand, their cost would be $9.00 per acre for that item alone against our cost for the same of $4.35, and while their plan might cost less per tree (only because more carelessly done) ours would cost much less for an acre but all of our trees would count as they are carefully planted and cared for, against their so-called cheap plan, with most of them doomed to certain death before useful growth can begin.

Our planting would be thicker than the space could furnish nourishment for and keep up growth beyond ten years, yet there is ample space for the young trees until then. Ours would be thinned in good time at a profit for thinning because of our annual artificial pruning, from the very infancy of the tree, while theirs could not be either thinned or pruned naturally (as their plan contemplates) within 25 to 45 years, according to species, and then a growth of only 2″ to 4″ in diameter of knotty wood can be expected.

The difference in first cost is greatly in our favor, notwithstanding the thoroughness with which everything is done by our painstaking plan. The saving on transplants alone is $4.65 per acre.

The plantings are usually on so-called wornout lands. We claim there is no such thing as wornout lands (unless washed away by erosion); if they ever did produce a crop they can do it again. Good drainage, proper rotation, fertilization and thorough tillage can make the poorest soil produce again. Clearing ground for farm crops is an expensive proposition.

Any plan that suggests the use of farm fields to plant forest trees is a step backwards, when with the increasing population the demand for bread stuff will be more and more, as time goes on. We would rather recommend the increase of our practice of the clear-cutting of the weed-woods, the inferior kinds and slow growing small trees, when not fully occupying the ground, and replanting instead of conservation of young growth, making the sale of the wood pay the expenses of a new plantation, as it takes nothing from the value of the farm or its income, to give value to what is now useless, an eyesore and a tax, a liability instead of an asset.

Inferior or slow growing trees should have no place in the woodlot as the same ground can grow a useful one. Nature does not discriminate. Under its plan the weed-woods seem to have the right of way.

Every report practically admits that Nature's process is too tedious and uncertain to be recommended, although there is much discussion on that feature of the subject, and they admit that artificial planting is the only way to get uniform stands and quick results with the kinds of trees wanted. None of them have had experience with annual artificial pruning; many advocate the periodical removal of the big and little limbs, by the old-fashioned method of axe and saw.

The relative difference of the cost of the two methods can be easily demonstrated by a little calculation, altogether in favor of annual prunings, to say nothing about the improvement in quality of the timber, or the increased growth or removing the menace of fires or the more economical handling of perfect trees, practically already lopped when the time comes for cutting. Few of the reports indicate experience in proper preparation of the soil, planting, fertilizing, inoculation, or care of forest trees, although intensive methods are used in parks, streets and avenues to the very limit, with results commensurate with the extra costs.

There is in these reports much information about artificial planting which is only in part on the intensive system and is of such recent date and so lacking in essential detail, as to throw but meager light on the subject but there is every evidence in the reports of recent date that the demand for the products is here, and the states are getting actively in the business, especially the nursery end of it, a most important one, but now of use only by residents of their respective states. Though on that line there will be little to fear as to the supply of proper plants even in those states that are not yet alive to the importance of the situation.

There is much information as to what certain great cut over states are doing in the way of restocking their barren and cut over lands, a movement that will always insure a surplus of plants; an exchange of species between the states may be of mutual benefit, and they should produce a higher grade of stock at a low price, and such as would be true to name.

Now that even the small trees of both good and inferior kinds can be profitably put into market, the situation is greatly changed for the better in that respect. They all agree on the fearful fire damage and on the cost of controlling fires but without an effort to fireproof the new forest.

The public practice is quite practical to meet a condition that does not exist on the farm, but with the states it can and will be used for many years to come. When the farmer, however, begins to get alive to the new situation relating to woodgoods, the state nurseries now well under way will more fully meet the real want then, and they will find it better and cheaper to get their transplants from the state nurseries at first, and the seedlings to be transplanted in the home nursery rows for use later on, than to bother with seeds or growing seedlings.

They not only agree that until prunings are complete only a low grade of lumber will grow, but that is not the worst of it, for as a matter of fact even the low grade grows so slowly in the thick stands recommended, that growth of any kind is too slow to make artificial planting a business proposition that a farmer would indulge in or consider if such instructions must be followed as are found in these reports.

Therefore, if clear growth and good quality can only be attained by pruning as is admitted in every report from which these quotations are made, then it is a self-evident fact that there can be no comparison between the two methods.

The greatest item of expense in reforestation by old methods is wasted labor and interest; time is the real thing that counts. We have already shown with the expense of our careful and thorough preparation and subsequent care, with all of the attendant cost of the intensive methods, to promote growth and improve the quality, the first cost by modern methods is much less than the old method, on the assumption that digging holes and buying transplants cost the same per piece in both cases. Therefore, there is no reason why the same ratio will not hold good for pruning and as all of our thinnings are cuttings for sale, we have no such expense as improvement thinnings nor do we have any risk of fires or insurance expense. So it will be plainly seen that if reforestation is to be considered at all, it cannot be successfully carried on with any halfway measures.

Even those reports that recommend periodical pruning with the more expensive operation with the axe and saw.

it is not only extra cost, but it accomplishes so little at every stage of the operation, after so much growth into useless limbs has been wasted. That adds expense for their removal, restricting the growth of the tree just that much, with but little clear wood for a long time after the periodical pruning.

And it is also claimed that excessive pruning weakens the tree and heavy thinning at one time increases the windfalls. Both points may be well taken, but neither occurs with the gradual thinning and pruning of our system.

We all admit the branches and leaves are needed to make a crown or canopy to shade the ground to facilitate the natural shedding of the lower limbs. Much stress is laid on the canopy cover. The idea was all right in its day of nature's production and methods. Textbooks claim that growth will be retarded by loss of leaves by artificial pruning. A moment's thought will satisfy any one that such retardation can bear no possible comparison with that from the thick stand and the sultry air incident to it.

Our claim that from the sale of the woodgoods already standing on the ground to be either clean-cut or reserved for conservation of the young growth of the proper varieties, funds will be provided for the preparation, plants, fertilization, planting, pruning and care of the replanted forest. There is nothing in these reports controverting that claim, except the lack of market for the inferior kind of woodgoods or of the smaller sizes of any kind, but there is where the condition has changed. Of course, on that point, even now much depends on location as to transportation to market and the kinds, grades, and quantity of standing trees on the woodlot. If the stand already there is not sufficient to meet the expense, the clean-cutting system may not be adopted. We do not attempt to prescribe hard and fast rules to meet every possible case or locality especially with the conservation plan.

It would have been just as sensible fifty or a hundred years ago to have said that thoroughbred stock was useless because "they would not pay," that it was impractical. Had that idea prevailed among the leaders of thought and progress (the go-ahead farmers of that date), we should still have to be content with nature's plan, but thanks to those far-seeing men of past and gone days, we are reaping the harvest of their wise forethought. It would have been equally inexcusable for them to have said we have no experience in raising maximum field crops, and it should not be indulged in because of the expense of preparation and cultivation.

Such a policy would never have made us a great people. Many of those pioneers of progress never reached the goal they aimed at, but they blazed the way for better things. We are dealing with that question entirely as a private enterprise, the only one from which the average farmer can be shown. They would otherwise never get beyond the idea so generally expressed in those reports, that it " takes over twenty-five years, and often forty-five according to species, before any clear growth can begin." But in very truth neither white nor shortleaf pines will be self-pruned to the point where clear growth begins in fifty years.

If weeds, briars, grass, sprouts, suckers, vines and bushes had to be controlled by man with a hoe, there would be no place for this book. But a man and a pair of horses can do more work than a dozen men with hoes, and with a tractor, the comparison is still greater. This is the age of horse power or its equivalent, in gas, steam, or electricity, to be guided by brains rather than brawn.

All that work of annual pruning and cultivation for keeping down those pests—every one of which is robbing the tree not only of plant food but moisture as well—can be done for less than three dollars an acre a year for a few years; such a disc harrow can easily cover ten acres a day, and besides what it does to the leaves and litter (by turning them under the surface) it does all that is necessary to fireproof the plantation and add to the soil's productivity. It is cheaper than fire fighting, and it accomplishes so many other things at one and the same time and usually without interfering seriously with the farm work.

When the first step in our practice has been properly taken, that is, drainage, without which worthwhile results cannot be obtained, it lays the foundation not only of the success on the planting but the improvement of the home, the farm, its surroundings and health. It makes cultivation and preparation easy and in season, not waiting for water to run off, as with undrained lands, the bane of all systematic plans. The loss of time from this cause alone accounts for so many failures on the farm.

We do not now claim that artificial pruning is a practical proposition for forests already grown or growing, but even that is an open question which we may discuss later on, but our system applies only to the reforested plantings. It is not only important and practical, but simple and inexpensive, and absolutely indispensable for a successful operation.

Trees seek the light and air from wherever it comes easiest. In the open fields limbs grow to the four points of the compass, a tapering bole after each successive set of whorls, the profusion of branches and leaves completely sapping the soil even beyond the reach of its longest limbs. Farmers do not have to be told early pruning of those trees in the open field would have adversely interfered with their growth in body or height. It might spoil a shade tree or mar its beauty, but we are now dealing with forest trees, and we claim that growth will be greater in height and average bole and with less taper with less than 20% of the tree from the top down with limbs and leaves, than with more if properly handled; and no farmer need go beyond his own woodlot to prove to his own satisfaction the correctness of this part of our claim, either on young or old trees, that is, that excessive foliage is unnecessary for profitable forest tree growing.

When you see a crooked, ill-shaped tree, investigate the cause (if time has not obliterated it); you will always see it was from a preponderance of limbs on one side in its early life that forced the tree from its natural upright position, the pinching off of a few buds or twigs, if taken in time would have corrected and made a valuable tree instead of a useless one.

The most diligent search will find no tree injured by early pruning but great damage can be shown by its neglect both in size and form.

In the avenues in cities, often whole rows of trees have every vestige of limbs lopped off, only to come again more than ever. In city plantings, single and double rows in the avenues or parkways, the intensive methods prevail without the help of the humus or without fear from excessive pruning which they lay so much stress on. Other substitutes for the little humus under our plan are quicker and more effective. But do we not more fully utilize the humus by incorporating it with the soil by disking as it falls instead of wasting so much by evaporation?

What is most surprising with our most careful search, we have failed to see, in any of the reports referred to, any evidence that the question of intense methods of culture and care for forest trees ever claimed even a passing thought of those officials in charge of an interest so vital to the public weal as the future supply of woodgoods either for present practice, or the lessons they might teach for future use. It should not be excused by the idea that "it would not pay" to practice such methods and let it end there, but it is a question that past experience either at home or abroad could teach so much.

This generation should have been instructed long before this as to the best methods of tree culture, how to raise maximum crops of proven quality, whether it could then pay or not, that is what we feel we should have had a right to know from those in authority, technically trained and paid to do such work, for it was well known the necessity for such training would come sooner or later, even without the war. Instead we find, in an effort to press the subject further, by private correspondence, many of them seem to think the question fully answered by saying, "it will not pay." We could not say the same of our English Cousins and the Colonial foresters. Fortunately for science and the future, such information has been studied since the days of Solomon, forgotten in the Dark Ages, revived in the Renaissance, its lessons handed down (in plain English, Latin, French, Hebrew and Arabic) and is available to those who will search. Much of it is better understood by the nursery men, the landscape engineer and gardener (in some respects) now only a little better than many hundred years ago.

It may not always pay to produce maximum crops (especially when there is an over production), but surely it is always a laudable ambition to know how and to strive for the best. We need not be told how to raise ten bushels of wheat to the acre or twenty bushels of corn, but we are always curious to know how to raise forty of wheat and one hundred bushels of corn. Though the method is rarely fully followed and the result seldom attained the easier, slipshod, makeshifts, will always guard against over production. It is quite true that even now, the public is not fully alive to the situation, some of the states instead of going ahead in forestry have actually withdrawn their appropriations, and doubtless the foresters will justly claim the service is handicapped for want of funds.

In addition to the reports from state foresters and official bulletins we have a mass of private correspondence on the details of the subject in which as a rule they all stand together and split hairs on theories and non-essential questions of no real interest to the plain farmer.

One from Yale, in response to our inquiry as to "growing cottonwood in his state for pulp wood." His answer "he preferred spruce for that purpose" (it being shown by several of the quotations, that spruce is a very slow growing wood, in one, that it requires 180 years to grow a spruce tree 12 inches in diameter). His objection to Carolina poplar or cottonwood, was that it was a "quick growing, but short lived tree," there could not be a better reason in favor of the use of that tree for our purpose, the filler in for the early crop, nor a better one for the rejection of his advice as to spruce, made in defense of their antiquated but academic teachings.

We want for our rotation the quickest growing tree we can get, and we don't care how short lived it may be if it serves the purpose, as all of the 363 cottonwood trees per acre should be ready to cut before the end of the first twenty-five years to make room for the slower growing, but more valuable pines destined for the continuance of the intermediate crop. Another, in reply to our "fireproof" claim, through early annual prunings and cultivation says: "fires are spread through the dry grass, and not through the dead limbs." He evidently overlooked our statement of the fact that by cultivation, we entirely eliminate even the dry grass and weeds. Another says "annual pruning will make the tree too tall and top heavy, and liable to break off by the wind." That statement might hold good with periodical pruning.

Another champion of a desperate cause contends that "leaf mould" is essential for supplying plant food to the tree. That tree must raise the leaves to fall and in turn raise the tree—something for nothing. What is to happen to the moisture while waiting for the leaves to grow and fall to make the mulch? Much allowance must be made for those who get their knowledge from books alone. Natural reproduction, thick stands, leaf mulch, natural pruning, the "survival of the fittest," natural thinnings were all very well in their day, and are still the easiest way for the remote forests and the shiftless.

Another contends that pruning live timber produces a loose knot. Overlooking the fact that with the early and annual pruning there would be no limb to produce a knot of any kind beyond an inch from the center of the tree. Still another offhand says: "pinching the bud weakens the tree to resist damage from wind storms, and that it would not prevent fires."

Still another says—"artificial pruning tends to make a tall slim tree liable to be broken off by the winds." If that point is admitted, there still should be no loss, with a forest tree. Quick growth is what we are after. Another says "it retards growth and tends to shorten the life of the tree." But even so, a broken tree or a short lived one, is not wasted. They all readily admit that no clear growth can begin until the lower limbs are shed, that it takes 25 to 45 years according to species to rot and shed them (and then several years more for some of the dead limbs to fall), and no growth of any kind worth while can be expected until the thick stand has been suppressed by the stronger trees. The low quality of the produce of such a system of planting and the slow growth alone should condemn it in these days of stress as a business proposition.

If results could be accomplished by that happy-go-lucky plan of leaving everything to nature, like the economical Irish alderman when called to vote for an appropriation "to buy gondolas for the park lake, suggested instead that they buy only a male and a female and let nature do the rest."

Our objection to the thick stand is that soil is overtaxed from the very start, taking years to restore its productivity before real growth would be worth while even after self-pruning is complete, and the sultry air incident to it required for self-pruning and thinning is death to the trees as well as the limbs. Extra plants are a serious useless first cost with time, money and labor thrown away. Artificial pruning is very much cheaper than the slow action of nature's forces on thick stands. The cost of the annual pruning for a few years is not comparable with either the natural or periodical plan.

The thick stand precludes the beneficial effect of cultivation, both for its help to produce rapid growth or high grade wood, or for fireproofing the planting. Another serious or fatal objection to the thick stand is that no intermediate crop can be had without which profits are too remote, as there are but a few trees over four inches in twenty years by nature's methods, reports say average is from 2 to 4 inches, that is, until they are self-pruned, then with the land so impoverished in nurturing those struggling wasted trees that more years will be necessary to start a real healthy growth.

We have entirely eliminated artificial seeding (either spot or broadcast) as being too slow, uncertain and expensive, and adopt and practice artificial planting with reasonable spacing and all of the helps that make up the whole of our intensive system, on the clean-cut woodland, except such young trees of the proper kind that may make conservation more desirable. Because, at Lotuswood, the proceeds of the inferior or weed-woods will more than pay the way for replanting and make room for a better tree.

This is our conclusion, after carefully considering all the reports referred to, notwithstanding it is pronounced by recognized authority to be not in harmony with the accepted ideas of the profession, we have cast antiquated theories behind us forever.

Harmless as they have been in the past, to follow them further under present-day conditions in the light of proven facts would be a crime to be excused only by ignorance or indifference.

Not that those quotations do not bristle with proof of the soundness of every one of the claims I make for my new system, yet the very air in the guild is astir with all kinds of silly objections to its practicability; but in real earnest, what can a rank outsider know about forestry?

CHAPTER XXIX

Estimated Profits from the New System

LET us see where we stand by the record on our original claim, for our system on our clear-cut land at Lotuswood, that we would have a crop of pulp wood ten years after the first planting, the year following the clean-cutting of the first one tenth of the woodlot.

Maryland reports show a maximum growth of loblolly pine from transplants one foot high planted in 1911—and measured in 1919—6¼ inches breast high (as it took two years to reach that height), it required no stretch of imagination to see that in 10 years at the same rate it will be more than 10 inches at the stump, if not destroyed by fire or checked by suppression, a danger quite imminent, as it is only a question of time when they must cease to grow because of crowding until the weaklings have given away to the stronger. That danger may be diverted by thinning and pruning, if not postponed too long.

We also have in U. S. Bulletin 24, page 24, Table 3, "cottonwood, 14 years old maximum growth is 14 inches," also a gain an inch a year and 75 to 100 ft. high in 12 to 15 years.

In neither of these cases was there any aid of the intensive system, but we have taken the measurement of the

Photo by F. W. Besley

Loblolly Pine planted in 1911. Natural pruning—and the fire menace, and knotty growth, of Nature's plan.

Photo by Courtesy U. S. Forest Service

Boles of White Pine in carefully tended grove Clermont, Fayette County, Iowa.

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largest trees. At a much smaller rate of growth for the following thirty years, with an average height of only 75 feet, there should be at the end of that time from a possible 660 trees to the acre (after leaving the 60 selected pines) 9900, 4 ft. sticks, that should require 45 pieces to make a cord. The total yield would be 220 cords to the acre from the intermediate annual crop, equal to 5½ cords for the 40 years from planting time, for each acre and year.

And leave 60 clear stem tall straight trees; if of loblolly pine they should average more than 1000 feet to each tree. This is discounting the possibilities that an earlier handling of the white pine may have been necessary but not probable. The present ocean freight rate per cord alone will amount to much more than the price of pulp wood that our estimate is based on delivered at our port of importation.

However, be that as it may, long before that time arrives there will be such a demand for the woodgoods from artificial planting for other purposes than paper making, that will make tree planters quite independent of present markets, as a little retrospection will forcefully show. A little more than 35 years ago there was but one band log sawmill in the entire South land. Less than 20 years ago there were over 20 within 100 miles of that first one with a daily capacity of over two million feet of kiln dried pine lumber, of which 5 were located in one city (this does not include the smaller air dried mills nearby) and it is doubtful if that region now yields one half of that output and that percentage will not hold long (and of that a larger percentage is of very low grades). Since ten years ago the competition with the veneer or ply wood mills for crating material has scrapped many of these big mills, and in less than ten years more the veneer mills will also be scrapped or moved far away from their present scenes of operation, because the nearby gum timber (of small market value ten years ago) will have been exhausted long before that time. And it is of too slow growth for artificial reproduction, in competition with our mixture.

It will then be seen that trade can hardly wait for even our first crop to grow to make packing box material, the market for which will be in the nearby cities for the sticks in the round, or to be sawed by operators in the vicinity of where they are grown. A very simple outfit already on the market is required to put them in shape for the domestic and more distant trade.

Such an outfit is quite portable and could be used as a community proposition or otherwise.

The quality of lumber that may be expected from those 60 trees before the end of the 50-year period by our system if such were available to-day, would be worth much more than we have allowed. At no time within the last ten years could white pine lumber of such quality be bought for $150 per thousand, or the loblolly pine for $30 and the latter is now worth more than twice that much. While pre-war prices for North Carolina Kiln dried pine, first and seconds, were worth more than $30, the fourth and fifth grades (the box and culls), the kind made of trees reproduced by natural methods or from second growth trees, would have been worth less than $10 at the point where the trees grew even if by the way of admission they would have been of size sufficient to make a saw log of any kind by the natural method of tree growing within the same time, which, of course, could not be expected.

We are offering the farmer no greater inducements than present prices for pulp wood, to clean-cut his woodlot and replant, but in the light of recent events he would have much better prospects for higher than for lower prices, as before all of the cottonwood will have been cut, the loblolly pine would then be a high grade saw log and of much greater value than the pulp wood.

Natural seeding and natural pruning were the methods in vogue in forest making when the *Mayflower* landed her Pilgrims on New England's rocky shores, and when Virginia colonists only a few years before saw on the banks of the James the operation of the same plan of nature. It was quite sufficient then and has proven to be all that was necessary, and all that could be indulged in during all the years that have come and gone even when the best specimens of the then matured trees were destroyed to make room for tillage usually by ring barking or girdling, deadening and then burning. No thought was given to reproduction even by nature's way, the already grown trees were to a certain extent considered as an evil to be removed rather than a blessing. It would be vain to lament the destruction of those magnificent trees, deliberately destroyed, but their room served several generations gone before a better purpose in helping to build a great nation. The sawmill, the church and the schools were the advance guards of our civilization. The flintlock rifle and the powder horn, the axe and the saw, the log cabin and the Meeting House, the "videttes," the very outposts of a restless people and in their wake were left a growing population in the place of the wild beasts, the earlier denizens of the forests. Then followed roads, canals and railroads, that opened up new forests that had long waited their turn.

Now when to higher cost of stumpage must be added the extra cost of the long haul, with the centers of population so far from what remains of the original forests, these facts alone emphasize the changed conditions that present the question to a farmer with a woodlot and a nearby market as a subject for consideration in an entirely new light.

The demands for the products of the soil in the form of food for man and beast required the ground then occupied by the trees, the question was then the easiest way to destroy them. Less than fifty years ago the very best trees were selected to be split into fence rails, when all farms were fenced on their boundaries, and subdivided into fields also, requiring an immense amount of wood for that purpose, far in excess of their requirements of these days, wire fences were then generally unknown. The most prodigal use and destruction made only slight inroads on those old forests.

There was then no such thing as a furnace in the basement or running hot water in the bathroom in the ordinary farmhouse, big fireplaces were the order of the day, with cheap labor to get the wood, and even with such demands on the wooded lands, its domains were relentless and purposely invaded by artificial means of destruction, the simplest method to that end was by that other useful natural element, the fire. But all that has changed, for a long time gradually, then suddenly.

It is now too late to preach nature's methods so well understood by the layman as well as the professional, and now known to both as unequal to the task of the present generation because of the long time it takes to accomplish so little, and by its wastefulness in producing so much not wanted: and the excessive overhead costs, accruing during the long wait for her tardy harvest. The cry of wolf has long been heard but now even the most skeptical knows the wolf is at our very doors.

The situation must be met by the experience of the past based on proven facts; and prompt action with all of the aid of art and science, with the help of power and modern machinery the farmers with the idle woodlot must hereafter be the mainstay. While the public, that is the State and Nation, is doing something in a very small way, it will be the millions of farmers that will be the real factors that must count in the production of an early crop of woodgoods if a calamity is to be averted. The sooner they begin to study their part the sooner the question will be solved.

Of the many millions of American farmers—suppose only a small per cent of them should realize that artificial reproduction of forest trees by the new system will pay. A million more or less of tree planters already equipped for the work of clean-cutting, replanting and future care, of say only one acre planted each year for ten or twenty years. At the end of that time one may imagine the contrast of that product with the plantings of the public, the States and National Foresters, scarcely five thousand men and women of all stations and ranks, a mere corporal's guard.

The idea that this ten years' growth of trees from each of the yearly plantings, is not lumber, is perfectly correct, as we generally understand that term. But they take the place of lumber and of woodgoods in so many useful forms so as to reduce the demand for real lumber. For instance, until it was discovered that so many of the so-called inferior woods made just as good paper as the yellow poplar that had been supplying that demand for forty years or more, good, bad and indifferent, big and little, all cut into cord-wood lengths and split to a convenient size for easy handling. Thus other soft woods 5″ and up mostly weed-woods took the place of one of the best timber trees known to the timber trade.

Prior to the early nineties the output of a good mill in Loblolly pine would average 60% of boards 12″ and wider. A few years later 30% of 10″ was a big average. The second growth pines were then beginning to constitute more and more of the output, until to-day I doubt if 10% of 12″ and up will not more than account for the average width in the natural home of Loblolly pine. Then a Standard Oil case required the ends to be each in one 10″ piece; now and long since that rule has ceased. Gum was then permitted to take the place of pine in a measure. Fruit and vegetable packages are now often made up of narrow pieces or of veneers or of both. From the Pacific Coast we still get packages of wider material from ancient trees that look down on centuries past and gone, so while the new woodgoods is not lumber of the old days, it takes the place of such more and more.

CHAPTER XXX

Intensive Methods not Controverted by the Official Reports. State Nursery Plants at Cost Helpful to Farmer

THERE is ample evidence that artificial methods must take the place of nature's plan, when time counts as it never did before, because it will not pay, neither will artificial methods without the intensive system pay the private operator.

The question, then, is what is the best thing to do. First get rid of the indifferent attitude of the foresters and their hidebound ideas, and self-satisfied, hard headed theories, and adopt sensible and practical ones to act on. The utter extravagance of the thick stand must be the first one to go. Then substitute a spacing that does not overtax the soil's capacity to grow and continue to grow, until properly relieved by harvesting the annual crop.

The whole system of successful or profitable artificial reproduction of forest trees stands on that one question. How can a thick stand meet the emergency? Will a thick stand pay a private enterprise? Is it for any other purpose than for natural pruning of useless limbs? Will it take forty years for clear growth to begin? Until then, will there be anything but a low grade of lumber of small money value?

On the other hand, can by proper spacing the ground begin to yield more and better lumber from the start by the intensive system? Will artificial pruning at the proper season of small lower limbs annually a little at a time diminish the crop of leaf growth essential to the growth of the tree? That is the only disputed point made against artificial reproduction by the intensive method so far as discovered.

We find nothing that definitely, specifically or positively attempts to controvert any of the claims we make for the system in any of those reports, but outside of them, their name is legion who say it won't pay, and who still stand by their old unproven theories.

If our work fairly puts the question up to the thinking people it has not been in vain.

We have frequently referred to the size of five inches as of commercial value. We do not propose to consider it for general use; while we also frequently refer to eight years, it is only in the case of accident that such a size will be used, in that time, as we will still be busy clean cutting and replanting until the beginning of the real harvest.

We are fully prepared to believe that the rapid growth by the intensive system may tend to produce a short lived and weaker tree, as quick come, quick go, but for our early harvest of pulp wood, it is the kind wanted; we are planting for a money crop and not for strength or longevity.

The intermediate early crop with the real forest only in the end, will it is hoped, attract the attention of the farmer, the future tree grower.

The only thing we can do to more intensify our intense methods is to place more top soil in the holes before planting time, as we would do in planting a fruit, lawn or street tree. There is no reason why it will not be equally beneficial with the cottonwoods and pines, on the theory of "what is worth doing at all is worth doing well." When we come to planting the pecans and walnuts and later on the oaks we may carry our intensive system still further by dynamiting the holes, breaking up the hard pan, or the clay crust.

Were it not for the free circulation of air and the prospective better market for cottonwood in the form of box shooks or crating material, or eventually lumber, we might omit the pruning after a few years (because pulp wood does not require such specifications), but such wood free from knots would make better paper or any other kind of stock, and be of more value to the paper mill because such wood at every stage of operation would be easier and cheaper to handle. Though quality is but one of the good results of early pruning, both quantity and easier handling counts large in value for our system. But above any other consideration the fire proofing of the planting is the keynote, and as soon as that feature is fully understood it will revolutionize the industry.

Let us see what this annual pruning that makes cultivation possible (and thus entirely removes the fire risks) will cost and the results carried out in dollars.

For the first few years the branches and the buds will be in easy reach of the pruner, and as the tree grows taller other means will be used to reach them.

The fact that only a little at a time when the limbs are small must be done every year, and that little in midsummer when the season's growth is nearly complete, after the sixth year the whorls of three seasons' growth instead of two, after the tenth season four or more whorls may be left; after the fifteenth year the pruning may be confined to the trees selected for the final crop.

The combined cost of this work is to a large extent only anticipating the final lopping of the limbs at the time of felling the tree, always an expensive part of the logging cost, an important fact overlooked by the strenuous objectors of forest tree pruning because of its excessive cost.

The cost of pruning and cultivating an acre of 726 trees should not cost more than three dollars a year in connection with the farm work.

Let us see what that systematic work will accomplish, say nothing of the benefit of the intermediate crop—or the fireproofing of the plantation, simply its effect on the 60 trees remaining after the 660 already sold for various purposes from time to time during and after the first ten years from planting time, as outlined in our general plan.

Instead of 15,000 feet of box boards, at the end of 50 years from the unpruned second growth pines worth $20 per M, $300 equal to $6.00 per acre each year, based on an annual growth of 300 feet per acre per year, we will have of the clear-stemmed loblolly pines 60,000 ft. of clear boards, worth $60.00 per M feet equal to $3600 or $60.00 per acre per year, based on an annual growth of 1200 feet per year.

The prices suggested in both cases are slightly below the market prices of to-day.

In the first case, there is no intermediate crop; in the latter case there is estimated to be a crop after ten years, for the next thirty years equal to $36.66 per year, per acre, or equal to $27.50 per acre for each of the forty years from planting time.

These are simply comparative estimates of probable results.

Suppose, for instance, those last 60,000 feet should be of white pine, instead of loblolly—at $150 per M feet? But we do not claim White Pine would make such a growth in fifty years, even under our intensive system.

These estimates do not include the cost of logging and of converting the logs into boards, which of course, bear on both grades alike, although the cost of handling the low grades are considerably greater than the cost of the better grades for reasons already explained.

The comparison in value between the high and low grades held about in the same proportion when lumber was selling so low, years ago, as will be shown in Loblolly or North Carolina pine price list tables. These extraordinary claims grow out of an estimated cost of three dollars per acre for annual pruning and cultivating for a few years, and occasional pruning of the sixty pines thereafter. The cost of preparation and planting by the intensive system has been shown to have been less than that of nature's methods.

We submit these figures as the possibilities under best management of the system rather to invite discussion, that may lead to a better knowledge of the subject.

There is no lack of admission that clear growth cannot begin until pruning is complete nor in the difference in value between the high and low grades, nor in the increased growth from preparation, drainage and cultivation.

But we lack actual official tests of the system as a whole, that is, so far as the United States or any of its State Forestry Service are concerned.

The question of the practicability of a continued pruning after ten years depends on probable profit over the cost of the operation. There will be no difficulty in the mechanical part of the operation. While it improves the grade and thus increases the value of the product, it certainly would pay but there is a wide cleavage on this point alone.

Eighty years for White Pine and forty years for Loblolly pine to be completely self-pruned, before which only low grade can be produced, as against the prompt removal of the lower limb as soon as it has ceased to help the growth of the tree.

That time comes when the three upper whorls have relieved limbs of the fourth season's growth, that is, from the top down, all such limbs practically cease to grow until the tree's height growth is complete, then such as are living and healthy begin to grow again slowly. Should they have been promptly removed the three upper sets of whorls would have taken on a more vigorous growth, and those limbs of increased size in length and diameter would have been capable of bearing more and better leaves and instead of retarding the growth of the stem it increases it, particularly at the top of the tree.

The mind of the forester is so obsessed with the idea that tree growth so entirely depends on the quantity of leaf growth, that it is not a debatable question, the idea springs from the books and not from the woods; to offer a suggestion as to the possibility of a shadow of doubt is rank heresy. It is perfectly ridiculous to say that a limb artificially removed promptly when it ceases to function, should retard the growth of the tree, more than if the same limb is permitted to remain, until in the course of long years by nature's plan it is self-pruned, until then only knotty wood can be made and a precious little of that.

The German Forester said "no one but a fool would prune a conifer" and that has passed at par ever since, with no effort on the part of the service to investigate whether it is a theory or a fact. The Germans are not infallible, they have since made some bad miscalculations.

It is high time that our service should know by positive proof and cease to assume that matters of such vital importance are facts.

The place to study that question is right in the woods where the trees grow, and not in the study, the school, the office or the laboratory, the proof is with the trees and not with the callipers, microscope or statistics.

The time so spent would not be missed, measured by results during the existence of the service for nearly forty years. Like the puppy dog chasing his tail, around and around in a ring, they seem to enjoy it but stop just where they started.

It is a sad misfortune for such talents to go to waste, because of assumption of theories as facts, while it is presumption for a layman (no matter how much he knows) to doubt.

The natural conclusion of the class of readers just referred to, is that they should stand by the foresters, trained experts, technical scientists, botanists that know trees and how they grow, against an old upstart who only pretends to know how to grow a few good kinds of trees and grow them better by a system admitted to be his own, and to grow them profitably, who is telling the English-speaking farmer that the time has come when he can do it and make money for himself by so doing. But it can only be done profitably when he makes a better tree by removing useless limbs, that eliminate the knots. The cheap kind of trees don't pay to grow, no matter "how they grow."

The question of pruning that has developed between this author and the profession is not so much in evidence in the quotations, as it is in the private correspondence and by personal contact.

They can neither demonstrate the correctness of their theories or disprove the claims I make for my system.

CHAPTER XXXI

A Comparison of Yield between the Low Grade, the Produce of Natural Pruning and High Grade by Artificial Pruning and the Other Aids of the New System

A Comparison of Value between Low Grade and High Grade Lumber

IN the early pages of this book, the details of our system are sufficiently complete for the guidance of the practical farmer to work out his plans for the future management of his own woodlot.

The quotation from the authorities, refer strictly to the clean-cut woodland (and only to so much of the conservation plan, as we find best fitted for Lotuswood). They are here reproduced for throwing all the light on the new system possible, whether favorable to it or not.

Any farmer contemplating the improvement of his woodlot, will do well to send for the bulletins from which they were made, for the fuller information on the same subject which should prove instructive.

Important as the subject of drainage is to the woodlot before planting begins, they dwell very lightly on that feature as it applies to artificial reproduction of forest trees.

But happily, the farmer need not be told of its importance in the growth of anything, or its effects on the health

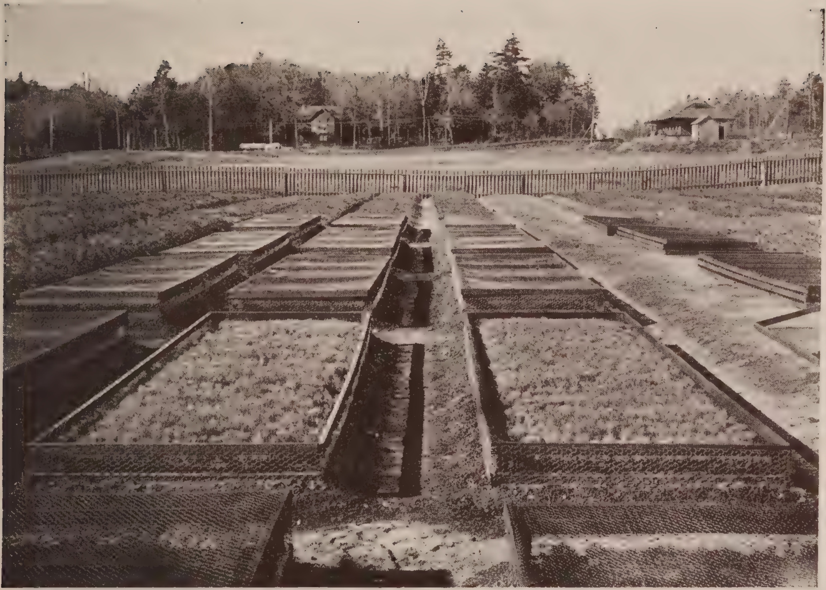

Photo by Courtesy U. S. Forest Service

Seed beds of 1-year-old White Pine. (Two of the beds uncovered to show the density of the seedlings.)

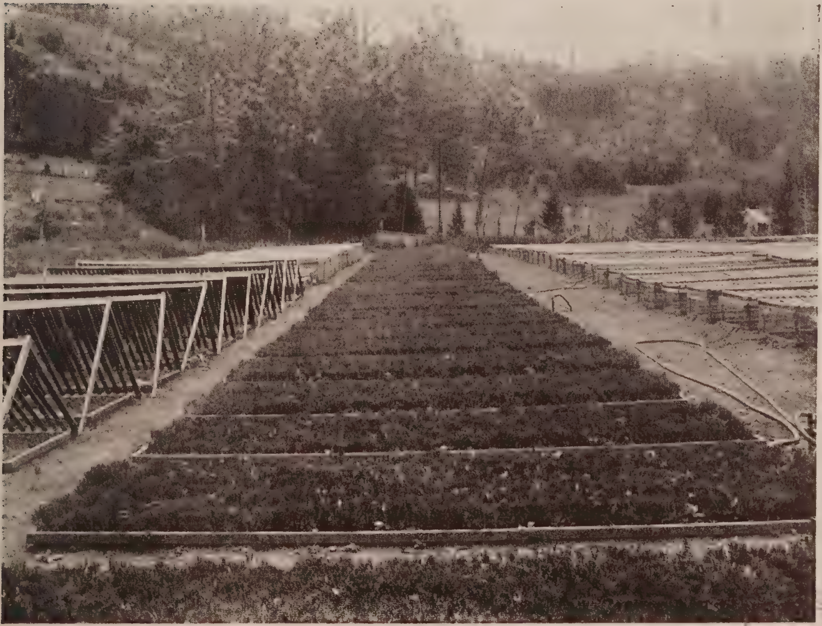

Photo by Courtesy U. S. Forest Service

Yellow Pine, 2 years old, in seed beds, Helena National Forest, Montana. Each bed contains 6000 trees and is 4′ x 12′.

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of the family and the home surroundings, the improvement of the farm or the destruction of pests and varments.

But such work can no longer be done without horse power, the day for ditching by man labor has long since passed.

Therefore the work in the idle woodlot must be that of power, animal, gasoline or the other useful agencies in that line. Otherwise, life is too short to engage in such work. This advice applies to every line of the various operations that will be involved. Use brains to direct power.

The quotations are in accord with my views as to transplants. The activities of the State Nurseries for forest tree plants greatly facilitates woodlot planting, no matter what the demand may be they will soon be prepared to meet it, with plants true to name and at prices that private planting of seeds or seedlings could not compete with. The statement of the Michigan Nurseryman that seedlings cost the State one dollar per thousand is a wonderful step, that indicates what we may soon expect nearer home.

Besides the farmers, foresters, teachers and scientists there is a large element of our people who may have no direct interest in the subject of tree growing but have a deep interest in everything that affects the real welfare of our country or of humanity. They may be lawyers, doctors, preachers, railroad men, statesmen, politicians, students or plan readers, who as a rule have no preconceived opinions of systems or prejudices for or against the natural method or the artificial plan. But they are a class that are ready to be shown. It is to them that much of the details of the new system are directed, as the judge and jury in matters that sooner or later must be reconciled beyond the point of argument or be dependent on further experiments.

The fine spun theories of whether the limit of limb and leaf growth is 20% of the height of the tree or 40%, or whether a limb should be pruned when one half an inch in diameter or one inch, or whether a system of pruning that increases the quality of the product of the tree from $20.00 per thousand feet to $60.00, should halt at a cost of $1.00 or so per acre or whether we should wait to prove the fact that it can or cannot be done at that exact cost. Or if the increase in yield of two to fourfold from cultivation at a cost of a dollar an acre more or less should justify the profession in withholding their approval of a system until the cost is actually proven. Or if such an important step in economy as fireproofing the planting by cultivation and annual pruning is worthy or not of serious consideration. No class of readers are more capable of forming their own conclusions than the ones just referred to when both sides are heard.

And there is no more mystery in pruning an acre of trees than in thinning an acre of corn or of cultivating an acre of ground that the plain practical farmer, with his own teams cannot solve for himself. Nor are there any more capable judges as to the benefit of cultivation of a plant or pruning a tree than the same plain farmer.

Pecans should be exactly spaced, requiring the removal of an equal number of growing trees; they if vigorous, may be transplanted anywhere there may be a missing tree, or a runt.

At the beginning of the new crop season, or even a few years earlier, room or space should be selected as the intermediate crop is removed for a still further planting of hardwoods, spaced 20′ x 24′ equal to 90 trees per acre, of which one half may be of the nut-bearing ones and the other half oaks, for the reason that there will be a great demand for the latter for piles and ties. While the white oaks are more valuable for many purposes, a mixture with red oaks will be desirable as they are less liable to disease and will prosper under more adverse conditions. Such a planting should be completed long before all of the cottonwoods have been harvested, and a further planting should proceed as the pines are removed so that at the end of forty years there should be 180 trees, which after the remaining 60 pines have been removed at the end of fifty years, the hardwoods would be ready with a continuous crop, when the railroads will be eager buyers, even though creosote has made the inferior woods answer their purpose in the meantime.

There is nothing we could do with that conservation reservation that would pay better than gradual artificial pruning of all of the trees large and small after the weedwoods have been harvested or destroyed, the kind of pruning in that case would be with the axe and saw, expensive though it must be, the relief to the tree, and the extra clear new wood if of proper species, that would be made in the ten years would fully justify the outlay; this we know is a radical statement in the light of other days, but times have changed.

Strange as it may sound to a timberman or a lumberman, we say it without hesitation that on any tract in which he has ten years to cut, there is nothing he can do after drainage that would pay him so well, considering present values, as a practical selection of trees for first cutting, and the careful pruning of some of the small and larger saplings more or less of which should be left standing after the first cutting. The profit would come not only in the increased growth but in the improvement in the quality of the lumber produced from the new wood, even though those pruned trees could have no more than five or six years to grow before the second cutting.

Of course all of the benefit would not result from the pruning, the increased growth would come mostly from the relief of the suppressed trees by thinning, but some of the increased growth, as well as the improved quality would be due to it, in this thinning and pruning process due regards being given to removing the brush. The operation would thus greatly improve the fire risk; I doubt not if the same outlay on the States' forests should be applied to pruning and thinning, that is now spent with fire wardens and watch towers, better actual results would soon follow.

The average timber man or operator will offhand ridicule all three of those suggestions, that is of drainage, of selection and of pruning the increased number of leftovers. At first glance he feels perfectly secure in his position, that "it would not pay," but he, too, need get rid of some preconceived notions, because the changed condition in the supply and demand for woodgoods, and the high price of high grades by comparison present a new phase to him as well as to the average farmer, or the owner of a woodlot.

The idea of draining another man's land is too absurd (he will say) when the contract of purchase and sale (or lease more properly speaking) did not call for it, but even so, if the growth belongs to the lessee, the extra growth and improved quality during the unexpired time of his lease will fully compensate for the cost even without considering the higher price of lumber these days. Then entirely aside from that reason, the improved condition of the logging operations or the smaller cost because of the removal of the surplus water. Such ditches should be economically made by power, attached to some of those simplex or climax ditchers (of course a wheel ditching machine could not be used in the woods). Original timber land owners disposing of their standing timber by the lease plan should make some provision in their contracts on that line, which should inure to their mutual benefit and the public welfare.

Regardless of what my opinion about artificial pruning of already established forest trees may be in general it has no place here, except so far as relates to the conservation of the thrifty full stand of young trees already referred to, after the weed-woods, defective, deformed, diseased and crowded trees are cut for market or destroyed for the benefit of those that remain, nothing can be done more helpful to the growth of those young trees than careful pruning.

Much judgment should be exercised in pruning well established trees of the conservation reservations: with us at Lotuswood, with our one hundred acres of that kind, in our rotation of ten years, the clear cutting and replanting is to be done after the routine farm work has had the right of way, so the needful help for pruning and thinning the young timber must be subject to the progress in clear cutting. But during the first year required to remove the matured saw timber, much can be done to improve the reserved stand, because of the necessity of a larger force in the woods for that purpose, but in that case the young trees should be pruned gradually, the lower limbs first, and such other limbs as are detrimental to form and growth.

The benefit of the intensive system in the natural forest is not so evident, as cultivation and regular spacing are not feasible. Nor can it be fire proofed like the replanted clean-cut plantations, but its early harvest can be greatly hastened by judicious liberative thinnings, keeping in mind the control of moisture, through the leaf mulch, and as time goes on, with the improvements from commercial cutting, fire protection should still be considered. And as the trees on any part of the reservation reach their best money value (after the first ten years, for any part of them) they should be clear-cut and replanted, just the same as the other 200 acres at Lotuswood. At a lower rate per year, that is, say, 5% of the remainder each year, so the entire 300 acres would be reforested within thirty years of the first planting. Then and only then can that part of the woodlands be fully fire proofed, and the land yield its maximum crop.

If time, help and management serve and question of doubt should come up, whether to increase the clean cut-ing and decrease the conservation, if every other thing should be equal, I should decide in favor of more clear-cutting and replanting, because of the resulting fire protection, and larger ultimate yield. The stand of thrifty young growths should be exceptionally fine, to promise as good returns in the first forty years as the replanted cut-over lands with the help of the intensive system. However, that would much depend on what kind of trees the young stand consists of, and the probable future wants of certain kinds. As for instance, in another fine young stand of white oaks where two hundred trees to the acre are not uncommon, none over twenty years old and all will be of railroad tie size during the next ten or fifteen years, after that crop is saved, the clean cutting and replanting will be in order there. The delay in clean cutting the young trees and larger growth is justified in the fact that they are growing while the more important clean cutting and replanting is in progress. There are, on these same acres, with the young oaks, a good mixture of loblolly pines, gums, and maples, that like the oaks may be held to grow until they become crowded or begin to crowd the oaks; in both cases the improvement thinning goes on, whether it is for pulp wood, fire wood, ties or for liberation.

While we have referred to eight years as the market age for the pines and poplars, it is not apprehended that they will be uncomfortably crowded at that age, if annually pruned, as then the growth will be in the bole and not in the branches of the trees, and while we are handling the woodgoods at the rate of 10% a year, we would not need the new growth until after the expiration of that time, except that part of them that should be removed when they begin to crowd; they then should have the right of way to market. The aim of the new system is to allow free circulation of air under the limbs and by proper spacing not overtax the capacity of the soil to sustain regular growth.

We have not dwelt on the details of the planting of the hardwoods, pecans, walnuts, hickories or chestnuts, especially with the latter because it may not be safe to risk them. In the case of the others, the soil should have three or four years of cultivation before the best results might be expected, before which time the question would be rather of varieties than of species.

We really have no wish or desire to attempt to cover the whole scope of tree planting or even of forest trees or commercial forest trees except the few of which we profess to be familiar, and known to be suited to the soil and climate of a great region at home and abroad and of such proven usefulness in the marts of trade as to commend them without argument.

There are many other forest trees that might be included in the lists, to my knowledge none more so than yellow poplar, or the tulip tree, also known to the trade as whitewood, a tree well known from the Lakes to the Gulf, and from the Atlantic to the Mississippi Valley, because of its usefulness. It was long used in paper making, even the smaller trees were prematurely used, before it was discovered that so many soft woods and some of the so-called hard woods answered that purpose as well or better. It has become the most valuable lumber on our markets and its reproduction will be a very profitable diversity in the selection of a mixture.

Chestnut and Locust should prove valuable additions to the list of commercial forest trees in sections where these may be found to be free from diseases, both of them rapid growers in their early years, and both are reproduced from sprouts. There is always a local demand, but only to a limited extent. But to enter into this question, we are getting beyond the object of this book, which treats primarily of a system, and not of a selection beyond the point of elucidating our plan of operations, the basic principle of which is artificial pruning for the gradual suppression of limb growth to make a better tree.

CHAPTER XXXII

Reasons for Our Selection

OUR selection of trees for planting at Lotuswood is not claimed to be the best for all sections, under all conditions. But in order to simplify our instructions a select few had to be determined on and considering the comparative freedom from disease, insect pests and wide latitude of successful and rapid growth, the universal recognition of their commercial value in so many lines of trade and general usefulness, they suit our purpose better than any other three trees we know of. There are many other forest trees of great commercial value, but none that we could recommend of such universal demand that over production would less seriously interfere with fair profits and a steady market.

Before the general advent of coal, coal oil, and gas for heating and smelting, vast areas were cut over for firewood and charcoal, both of which have been largely eliminated by coal and coke. But the demand for mine props, ties and timbers soon made greater inroads on the woodlands without utilizing the weed-woods (as did the charcoal burners), thus leaving the cut-over lands with a growth that fully occupies the lands, without hope of reproduction of any useful thing except by artificial means. Then only after clean-cutting and replanting.

Circular No. 41, Forest Service, 1906, says: "Statistics compiled in 1902, of the Geological Survey, report Pennsylvania as having one half of the coal, and two thirds of the coke production of the United States." "The rapid growth of steel and coal industries has caused a great increase of population in that state. Agriculture has been slowly going backwards for many years." "Largely by the money acquired from the sale of their farms, has led many of the farmers to retire to the towns."

"There still remain great sources of coal to be developed, but the field is sure to shift. The principal vein, the Pittsburgh in Westmoreland County, has been exhausted, in other localities in this county 30 to 50 years will complete mining operations." (That was said 20 years ago.) So 10 to 30 years will see a great economic revolution. If it means back to firewood and charcoal, can we begin too soon to be ready when it comes? The source of timber supply is becoming farther and farther distant, a growing scarcity of pit props and correspondingly high prices are being paid each year. In former years only oak was accepted for posts, to-day all kinds of wood are utilized.

The jack pine thicket at Lotuswood, now about 60 years old, in places stands very thick on lands turned out from cultivation during the war between the States. The slow process of time is still doing its work of self-thinning and pruning, with apparently several years ahead before the work is complete. The mulch of pine leaves or straw is all that could be desired, soft and yielding to the tread; it has long since accomplished its work of suppressing the undergrowth of weeds, briars, grass, etc., with all of the benefits of the conservation of moisture and the conversion of plant food through the leaves, yet after all these years, because of the thick stand and the vitality of the trees, thinning goes on so slowly that there has been a yield of a little less than a cord an acre for each year since the same ground produced a farm crop, as the corn rows yet there and the farm tradition attest.

At first glance at the record as to forest trees on the whole, I appear to be in advance of the times, yet, on a careful analysis of the details, where good results are expected, and accomplished, the best methods only are taught. In lawns, parks, avenues and private planting, our methods are actually intensified. We do not appear to be in accord with text books as to exotics, that "trees found in their natural habitat, are always the best for local planting"; the idea seems to be only academic, but in reality very important. We furnish proof from the records that White, Loblolly, and Corsican pines all do well in far Australia (12,000 miles or more from their natural homes). The White or Weymouth pines of England also do well there, the "pinus tæda" outstrips them all in rapid growth.

The necessity of excessive limb and leaf growth is another one (as applied to forest trees), we claim that hundreds of trees are helped to one hurt by so-called excessive pruning. We are in full accord as to the necessity of pruning and thinning before clear growth can take place, we only differ as to practicability. Nor do we differ as to the importance of the suppression of weeds, grass, etc., except as to methods. Ours is the better, quicker and cheaper way.

It is to the millions of American and the many more millions of European farmers, with their woodlots, that we must look to in performing this useful and profitable service, and the time is now ripe for action.

Among the many points of attraction to the farmer in our new system of commercial forestry is that, we make the woodlot pay its own way. And that the woodgoods and weed-woods may be handled and the woodlot restored so as to make it an asset, and transform a sorespot into a thing of beauty, at a cost slightly more than the ordinary cost of operating the farm.

It is no puzzle. Why? Because with the first step, that is, complete drainage, instead of idle teams and farm hands waiting for the water to run off and dry up or evaporate (because of imperfect drainage), they are steadily employed with the soil in perfect condition, that the work is not only kept up with the advancing season, but easily ahead of it, so that the same work can be done with a lighter force of men, as well as teams, and instead of reducing either they are kept on in full force all the year round, and steadily employed in the woodlot after the farm crops have had attention. Not only for the benefit to the growing trees and the general economy growing out of steady work, whether it may be in the woods or on the farm.

The omission in these reports of reference to the harm done by the most insidious enemy to successful tree growing is very surprising. It is vastly more dangerous than the combined agencies of fires, fungus, insects and disease, that is, water, its excess when not wanted and its scarcity when needed.

The results will be the same, whether the woodlot is to be clean-cut or partly so and replanted or if part of the stand warrants the conservation plan. The only difference in the latter case, the work is practically all done by man-power. The stand should not only be thrifty and sufficient to fully occupy the ground, but of such varieties that are quick growers and which are in such general demand as to afford maximum money returns from the soil. Those that do not come up to that standard should be treated as weed-woods which fortunately now have a market value beyond the cost of handling. Their place should be promptly replaced by more useful ones that respond to good treatment.

With the same complete drainage, many wet, springy soils, the heads of ravines, branches, cripples and waste spots, and with the same methods of clearing the clean-cut woodlands for replanting with power, team or tractor, may easily increase the tillable acreage of the farm for farm crops and not diminish the yield of woodgoods and improve its appearance and value and increase the revenue from the farm crops. A planting of trees need not reach maturity to be of value.

My experience in drainage is largely with comparatively level lands, yet susceptible of perfect drainage. I never saw a perfect stand of trees where the drainage was imperfect, stands with perfect drainage sometimes running from fifty to one hundred thousand feet per acre. Of the many tracts that have come under my observation, I do not recall one as large as forty acres that would average 60,000 feet without a bare space, but many that would yield at the rate of over a hundred thousand feet on some part of the acre. That very fact, coupled with an average stand of four to five thousand feet per acre, in the natural home of the loblolly pine, indicates what a scarcity there must have been on so many other acres. In nine cases out of ten, the cause can be traced to imperfect or the lack of drainage. The drainage of the average flat land is not a difficult problem.

The average production of a crop is the mean between the highest yield—the result of the best method, and the lowest, the result of a poor method.

And it is just that point that will explain the claims that I make in the apparently extravagant yield of wood-goods under the intensive system all the way through these pages, that is, to aspire to maximum forest as well as farm crops. By securing a full and proper stand so that all of the ground may be doing its part.

Without proper drainage, the yield per acre, even by artificial planting would be nearer 20 cords in forty years than two hundred and twenty. With it, all of the artificial helps count, without it, none are worth while.

I do not refer to swamps, the drainage of which the farmer is not equal to, but to the ordinary woodlot, that so much of it is under water part of the season, and the other part dried up, parched and cracked. Drainage, pruning and cultivation all come in with the intensive system, each depending on the other for best results.

Water, its excess, when and where it is not wanted and the lack of it when needed is a handicap that must be overcome before real success is possible. Artificial drainage helps to carry off the excess, that hastens a condition of soil that permits cultivation, to make the mulch to absorb, retain and control proper moisture.

It is here only meant, such surface drains as the average farmer is familiar with in the operation of his ordinary farm fields to facilitate the growth of his usual crops. On level lands such drains are desirable to be as straight as practicable, such work is greatly facilitated and cheapened by the use of horse power instead of man power. We cannot lay down positive rules to meet all conditions, ordinary good judgment is sufficient.

Without drainage, work in the woodlot would be as futile as in the field crop. With it, and cultivation after pruning, maximum results may be expected. It provides for the removal of excess water, and the retention or conservation of useful moisture.

No matter what the soil may hold in the mineral elements of plant food, and what agencies are employed to make them available, all would be useless without water, air and warmth. Plants get the water required for growth from below by a process of capillary attraction which ceases to function while the soil is in saturation. Hence the necessity of surface drainage to quickly get rid of the surplus water, to hasten soil condition that permits cultivation before the formation of a crust that increases evaporation that cools the soil and thus retards growth, which can only be avoided by timely cultivation of the soil for the

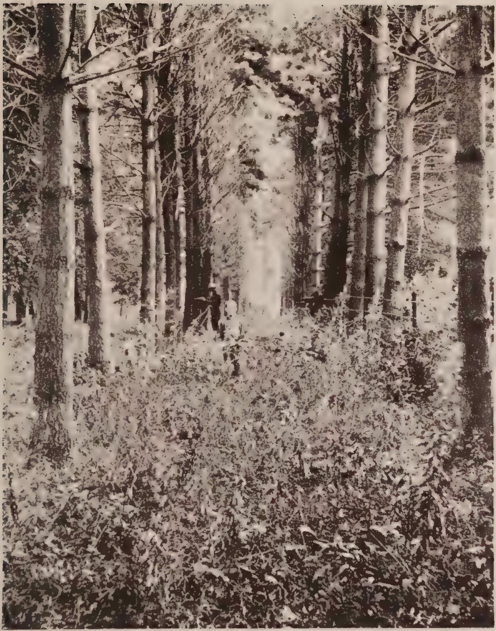

Photo by Courtesy U. S. Forest Service

Looking down two rows of White Pine, 35 years old, showing way in which side branches prune themselves.

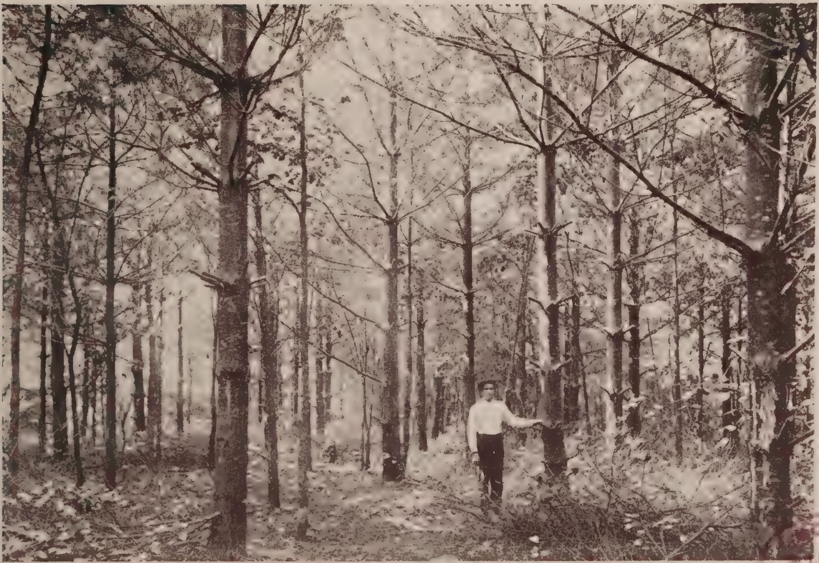

Photo by Courtesy U. S. Forest Service

Pruning of White Pine which was allowed to form heavy branches. Close pruning would make the wood split or cause the extensive bleeding of the Pine. To prevent this they are not pruned closely but 2 and 3 years later the stubs will be pruned. Biltmore, North Carolina.

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retention of the needful quantity of moisture to promptly restore the capillarity, thus drainage and cultivation are the active artificial agencies that promote ideal conditions.

Cultivation would be harmful if done when the soil is too wet. Without drainage, the time consumed while waiting for such condition besides interrupting the growth of the plant, would permit the growth of grass and weeds that in turn consume the moisture soon to be needed for the plant and hastens and intensifies the drought. But with drainage, the soil rapidly becomes in condition for the cultivation that at once puts into activity all of the agencies for healthy growth, and at the same time prolongs the benefit of proper moisture. The finer the soil by tilth, the greater the capacity to hold the water.

During a steady, moderate rainfall, a well-cultivated soil should hold for a time all of the fall, but when continued beyond the stage of full saturation then the ditches come in for a share of the good results from the combination.

Not only from the mass of information here gathered, also from the excerpts of the Forest Service of very recent date do I find my system as a whole to be a more important discovery than at first occurred to me, that is, that there is in no department of the States Forestry Service or of the Nation any claim to or admission of knowledge of the practice of an intensive system of artificial forest tree planting and care, or any other system that promises profit to the farmers in restocking their woodlots.

Since I in great detail describe the new system that if faithfully followed will provide them with profitable occupation in the conversion of their woodgoods into money, and their idle woodlots into a thing of value that will yield a regular income constantly increasing as time goes on.

CHAPTER XXXIII

Increased Price of Pulpwood

REFERRING to a later report of the National Forest Reservation Commission Document, No. 901, so far "its activities are confined to the protection of the present stand and to the acquisition of more lands of the same kind." But they are preparing for nursery stock to begin to restock some of their burnt-over areas.

Whatever they do in that line, even though it be not of the intensive system, will be just so much to the good as immediate profits or returns with it are not so important as with the farmer and his woodlot or the private planter.

The nation will have a constantly growing asset but what it could do with its paid force of foresters in the way of meeting the emergency would be but a drop in the bucket as compared with the army of ready-made tree planters, when they are ready for action.

In substantiation of our estimated returns for wood-goods, I quote from page 15, "In 1900 the average price per cord of peeled pulp wood in New England was $5.00; in 1905, it was $5.50; in 1915, it had reached $8.25 and had increased to $19.00 in 1920. After deflation of war prices it was $14.00 per cord in 1921."

"The stumpage value of timber suitable for this use has increased at a far more rapid rate than has the price of the wood." "A reliable guide of the relative amount of this material which is available in the North Eastern States." The last U. S. Census, of 1920, shows we have in round numbers about 6½ million farms averaging 148 acres, of which 70 are unimproved, the greater part of which are not wooded. The estimated yield per acre per year is said to be about 300 board feet, in natural forests.

The largest output of American sawmills in one year is said to be 29 billions, but by our system of artificial production 1200 feet per acre per year in a rotation for 50 years would make 60,000 feet per acre without counting the intermediate crop.

That yield would require good management but by no means a maximum crop. If only one half of those farmers would clean-cut and replant one acre each a year for 10 years at the above yield, the product would exceed that of all of our mills their best year by several billion feet, and that would leave 93% of the unimproved land untouched and no farm land used for that purpose.

CHAPTER XXXIV

Insignificance of States' Efforts Compared with what the Farmers can do

A LEAFLET issued by the Chief Forester of Pennsylvania, who was formerly the Chief of the United States Forest Service, recites some facts and presents some figures both of which are significant and interesting, touching the question of artificial reproduction of forest trees in that state by the "so-called established laws governing tree growth as approved by expert foresters, or such as were not questioned before the advent of the 20th Century."

"In the course of 21 years it had planted 37,000 acres," an average of a little more than 1800 acres each year during that time.

Allowing the average annual production by the approved plan to be 300 feet per year per acre, the yield would be a little more than a half a million board feet. If in the shape of saw logs not enough to keep a moderate-sized modern sawmill supplied with logs for one week or one big one, only a half a day.

He also stated "his state has 200,000 farms with an average of 20 acres each in woodlots." If they would clean-cut and plant only one acre each, it would amount to nearly six times as much as it has planted in the entire time (21 years) it has been engaged in planting.

By pursuing the intensive system the produce should be for 200,000 acres—240 million feet, nearly five hundred times as much and valued according to its grade would be worth $48.00 per acre per year.

I do not pretend to say all of those woodlots are of such character that the intensive system could apply, but if so, what would be the result if continued at the same rate for 20 years, when all of the woodlots would be clean-cut and reforested, and those 4,000,000 acres of woodlot comprise less than one third of Pennsylvania's woodlands.

The potentialities of that great army of ready-made trees planters are completely ignored, and they go plodding on in their own way, ridiculing the idea that 1200 feet per acre can be produced by our system, yet they all admit that every one of the points in it will increase the yield over nature's way, and that pruning will improve the quality.

It requires no very vivid imagination to compare a system that fully occupies the ground, with no bare spots on prepared surface soil and holes, fertilized, inoculated and limed, cultivated, pruned and thinned, with a selection of quick growing trees, planted to live, as against the method practiced in that state of planting 1200 to 2800 trees to the acre, planted to kill each other and then left to their fate, and the fires, and it is admitted that such a system will produce 300 feet per acre, but in any time less than 60 years, it must be of a very low grade, of small value.

In the earlier pages of this book I have described four notable bodies of loblolly pines (and it is admitted that cottonwoods are more rapid growers) one of which I had known of all my life, as the Wye town woods, near the site of Doncaster outside of Virginia and Roanoke Island, probably the oldest town site of English-speaking people that can be located in America, some years before the settlement of St. Mary's, contemporaneous with Claiborne's trading post on Kent Island (the site of which even tradition cannot locate). The latter was a settlement from New Kent, Doncaster was from Nansemond County, Virginia—the ancestors of its present owner in an unbroken line have held it since before Bacon's rebellion, but they were not the pioneers.

All this is somewhat foreign to the subject except that the history of the Wye town woods is not mythical. I cut that wood nearly forty years ago, it was then nearly 70 years old. I have known it first as Wye town thicket, but after its sapling stage, and after it had been self-pruned then called Wye town woods, many acres of which yielded over one hundred thousand feet or more than 1400 feet per acre for every year of its growth, especially those acres bordering on the cleared fields—the entire tract averaged 900 feet per acre per year.

Had those trees been thinned to a number that the soil was capable of nourishing and persistently pruned in their early days the difference in the quality of the wood even in those days would have paid all of the extra cost and harvest could have been twenty years earlier.

That leaflet further states—great as was its output of lumber years ago, now Pennsylvania produces less than 20% of what it consumes, and that 13 paper mills get from beyond its borders, 74% of its pulp wood.

That state of things will continue until the trained foresters forget for a while what they know about tree growth, and begin to study how to grow trees. Until that time comes, their preaching will be about as effective as fishing with a pin hook. Or as futile as the efforts of the Chief Forester of the United States trying to arouse the interest of our lumbermen to reforest cut over lands.

In his speech at Jackson, Miss., on the 8th of February, 1922, he asks: "Who will grow the trees?" He says the "citizen passes it up to the State and the State to the Nation, and the Nation up to the babe in swaddling clothes."

But he did not give a passing thought to the real factor (the farmer) in solving his problem, when they get busy with their idle woodlots, their teams and tools.

Those foresters are a fine body of men, a close corporation, true to their chiefs, and true to their clans through all administrations, good talkers, ornaments to society and their guilds, maintain the dignity of the service and their bureau. But somehow they seem to stand just where they started nearly forty years ago.

Scientific to their finger tips, technical to obscurity, know their lessons well, books say so, no mistake, sure thing.

And when they open a broadside of their vocabulary of technique, there is nothing to do but surrender.

The Forestry Associations, State and National, take themselves seriously, their members are well versed in forest lore and book learning, and talk trees, arbor culture, etc., glibly. They are part of the craft that dwell on established laws.

But the public, the press, the pulpit seem to agree with them, and take them all as seriously as if they had really accomplished something useful. But somehow the practical lumberman never did. The one big mistake they make is the idea that so fully obsesses them, that the farmer can know nothing of how trees grow, and in that idea they seem to be on the popular side of the question, even with the farmers themselves who have watched trees grow all of their lives. It is a big proposition and one that will not be met by the sentiment of arbor days, Christmas trees or roadside planting, all very well in a way. But it will be met by that sturdy body of men who feeds the world and wins the wars, the real prop of our civilization.

We find nearly at the end of the first quarter of the 20th century they have made no progress that tends to meet the wants of the age they lived in or a movement in that direction but are yet right where they started.

We are forced to admit the paternity of our own system of growing trees. The key to which is annual pruning of the small limbs beginning with the small trees, and to continue as long as it is practicable.

It is a discovery that will be epochal in commercial forestry and in the world's domestic economy.

A discovery that the farmers are ready to utilize, with which they will meet the issue as they always do when a crisis is at hand.

The reason it is a discovery is that it had not been combined as a whole before, the sentinel had been asleep at his post, as is attested by the failure to find a forester who had experience in an intensive system of forest tree growing, or a picture of it among the thousands in stock; some believed, others doubted, more that it would not pay and others denied its practicability.

As it is a discovery that is "not in conformity with (man-made) laws governing tree growth," the profession assume no claim or responsibility for such a system and leave the merit or onus to us, which we modestly assume as is shown in the correspondence that here follows:

CHAPTER XXXV

Excerpts, Official and Others

THIS manuscript describing our new system of forest tree planting and care, utilizing the skill and labor of the farmer, his help, teams and equipment in handling his woodgoods and in restocking his idle woodlot, was submitted to the Department of Agriculture and by it to the Forestry Service.

Following are excerpts from some of the letters on the same subject, indicating a wide divergence of opinion on that one question.

EXCERPTS FROM LETTERS
FROM THE
DEPARTMENT OF AGRICULTURE, AND ITS FOREST SERVICE

From letter of Henry C. Wallace, Secretary, dated January 10, 1922.

"I am referring your letter and manuscript of your book 'Forest Trees,' to the Forestry people. They will, I am sure, be glad of the opportunity to consider it."

From Col. W. B. Greeley, Forester, January 30, 1922.

"After a careful consideration of your Manuscript there appears nothing we can helpfully add to the comments already made by Mr. Ashe. You have assembled a mass of information *and have developed certain views of your own,* not all of which are in conformity with the established laws of tree growth. Others may have practical merit, if properly worked out."

"The Forest Service appreciates the opportunity you have given us to examine your manuscript and your interest in improved methods of Lumber Production."

From W. W. Ashe, Esq., Forest Inspector.

"Your theory of pruning small branches is only applicable to small trees, say up to four inches in diameter. Larger ones must have larger branches. A tree eight inches must have limbs one inch thick, and larger ones in proportion, otherwise there is not enough foliage, and its growth is checked."

"Until you have demonstrated the practicability of securing a clear stem by pruning small limbs only, and the cost of such works . . . people like to be shown."

From C. W. Pugsley, Esq., Acting Secretary, January 30, 1922.

"The Forester informs me your manuscript has been given careful attention by several of his best men, and he has written his conclusions. I trust you may be able to develop your ideas in a way to make them widely useful."

From W. I. Hutchinson, Esq., in charge of information.

"The Forest Service is perfectly willing that you should publish the letters from Col. Greeley and Mr. Ashe in your forthcoming book."

. . . .

Excerpts from "Practical Sylvi culture," by Professor Ralph C. Hawley, 1921, page 198.

"Pruning trees is for the purpose of increasing the quality of the final product."

"For the production of clear lumber the early removal of all limbs from the main stem is essential."

"Nature's process requires great density with correspondingly slow growth."

"The long rotation which in virgin forest has accumulated stores of clear timber under nature's methods cannot be tolerated in the managed forest due to the poor financial showing."

"In plantations, artificial pruning has special weight." "In order to save time trees are set out at the rate of 800 to 2500 trees per acre."

"As compared with stands of several thousand trees per acre starting on areas naturally reproduced." "Such plantations if they are, to yield clear lumber, demand artificial pruning." An example of live pruning on white pine for four years, beginning in 1916, where 112 trees pruned and 169 trees unpruned out of a plantation of 1210 trees per acre were selected for the test the pruned trees made a height growth of 6.88 ft. and the unpruned trees made a height growth of 7.36 ft., a gain of less than half a foot in four years or 1½″ per year; the table does not indicate whether the 169 trees were selected as the best, worst or average of the whole plantation. It has been cited as an argument against forest tree pruning. The table is significantly silent on the diameter growth. We are surprised that such a severe treatment as the removal of all of the branches of eight years old white pine trees, 6 to 12 feet high except three whorls and in some cases leaving only two whorls at one time did not reduce the height growth much more than one and a half inches per year.

We do not even claim a large increase of the diameter growth at the stump but our strong point is that the artificial pruning of the lower limbs, a little each year, increases the diameter growth all the way up to the lower limbs, reducing the taper, and making a clear stem from the start, instead of waiting thirty years, as that author admits is required for self-pruning.

In a thick stand, the only thing a poor crowded tree can do, is to grow straight up, where there is no competition, a tall, spindling, exhausted plant, destined to die before a useful purpose may be served.

"Pruning of live limbs to a limited extent (not over 10% of the depth of the limbs area) is not likely to have injurious effect, if done when the branches are small."

The pruning quoted from which the trees lost one and a half inch in height per year for four years also involved a loss of fifty per cent of the crown in one year.

And the work was not done at the proper season that should produce the best results.

"If the financial returns made possible by pruning are large, then it may pay to prune an additional log or two."

"Pruning should be started early because the limbs then to be cut will be smaller and the core of knotty wood already produced will be of small diameter."

"It will require three or four prunings to clear the trunks 16 to 25 feet above the ground."

"In pruning live limbs, it is best when the tree is dormant."

Experience shows that the best time to prune a forest tree, especially a pine, is just before the dormant season begins, as the exudation is still so active as to seal the wound from danger of fungi, and to insure its complete recovery before the next growing season.

"Pruning is an operation, particularly in plantations, that will be employed as a regular part of the management. It may then be possible to lower planting costs by the use of wider spacing, than with natural pruning."

Page 156:

"The advantage of thinnings, as compared with Nature's unrestricted competition."

"The length of time required to grow products of the desired sizes can be shortened."

"Not only is diameter growth increased, but to a lesser extent, growth in height."

"The popular idea that height growth is directly dependent upon and increases with density is unsound."

"Height growth will be greater when trees are kept in a vigorous condition found in the properly thinned stand."

"Thinnings raise the quality of the final crop. Trees of poor form, defects and inferior species can be taken out, and on the few remaining growth will be concentrated."

"By thinning the total yield, both in quality and value of product on a given area and specified time, will be increased. *Thinnings furnish financial returns early in the rotation.*"

It is not always that circumstances will permit us to take advantage of the very best time to prune for many reasons; not the least of them may be the hot season, and other pressing duties then prevailing.

But it is not so hard to avoid doing the work at the worst time, which is just before the bursting of the buds into leaves, the time that every twig and branch is charged to its limit with moisture for the growth of the leaves the storehouse for the future growth of the tree.

A test case as to the worst time to prune is here noted; a branch of a grape vine was pruned at that exact time, April the 10th, it exuded two drops of water per second, and after 24 hours, at the rate of one drop and the day following it was still dropping—in that time the swollen buds were small leaves; they continued to grow until the 20th, when they ceased to grow, and on the 30th they had withered; by the 20th of May they and the branch were dead. Prunings of the later date had no such effect on either the branches or the leaves.

Branches can be safely pruned just before the end of the growing season, while the bark still slips and in the conifers the resinous matter still flows. But if later it will be at the expense of the growth of the tree, more or less according to the time before the new growing season.

We have dwelt on the teachings of this author because of the recent date of his work.

And while it verifies all we claim for pruning and thinning, there is a complete absence of a new idea in the work or one that a practical tree planter can utilize, but it has a learned discourse on a theory that is as dead as the Dodo, the alchemist or the astrologer. Yet, it will be studied with avidity by the professional forester and his followers, but it will encourage no tree planting.

Photo by Courtesy U. S. Forest Service

A 9 to 10 year old stand not ready for thinning.

Photo by Courtesy U. S. Forest Service

Seed beds of Red Pine, 2 years old. (These beds contain 12,000 to 15,000 trees in a 4 x 12 foot bed.)

Letter of W. W. Ashe, Esq.

March 28, 1922.

DEAR MR. TUNIS:

Referring to your letter of March 11th, and the three questions you ask therein:

1. Will artificial pruning injure trees?

No.

2. Will it retard growth?

A limited amount of pruning will not retard growth.

3. Will it influence the quality of the wood?

The smaller the limb which is pruned the better the quality of the wood.

EXCERPTS

From Letter of W. M. Baker, Asst. State Forester, Trenton, N. J., April 20, 1922.

What you have to say about intensive methods of pruning and cultivation is interesting . . . conditions for the practice of forestry in New Jersey are ideal and we are probably as justified in using the intensive methods here as anywhere in the United States. . . .

"However aside from all of this it is interesting to know that some one is making an intensive study which will result in established facts. In my opinion, foresters, of necessity, have gone too much on assumption, which, in many cases, has been proven incorrect when the matter was fully studied out."

Letter of H. O. Cook, State Forester, Boston, Mass., April 17, 1922.

"We have your letter and circular describing your system of Forest Planting and Pruning. I am much interested in the possibilities of early pruning in the development of a forest crop."

"I refer you to Professor T. B. Knapp, from him you might obtain valuable data."

From Professor B. E. Fernow, the Dean of the Forestry Service in America, letter of April 30, 1922.

"Inasmuch as increment is dependent on amount of leaf surface, early pruning must necessarily reduce increment, and that pruning effects a change of location of increment."

On the latter point we are entirely in accord, on the first and second points, all depends on whether the gradual pruning of lower limbs (usually weaklings) does not correspondingly increase the growth and vigor of the upper ones, and increase their capacity to grow more and better leaves, and thus increase increment; dislocation of increment is our aim.

From letter of Charles C. Dean, Esq., State Forester of Indiana, April 20, 1922.

"We did pruning in a scientific way on Catalpas planted 5′ x 5′ (1742 trees to the acre)."

"I am convinced it does not pay." "My notion is to plant close and depend on natural pruning."

What scientific purpose could be expected from pruning one thousand and more useless trees? that must be dead before a useful purpose could be served.

Artificial pruning and a thick stand is an inconsistent proposition.

From F. W. Besley, Esq., State Forester of Maryland.

"As to pruning lower branches of Loblolly pine, grown on short rotations, this would produce only a low grade lumber at best. In the case of White Pine grown on a longer rotation, the pruning off of lower branches might prove profitable."

"Because of the high initial cost and the heavy expense of cultivation and pruning, it will not pay."

"The only practical pruning is to remove the dead and dying limbs. Using the term 'dying limbs' to indicate those which are beginning to fail in assisting the tree in the process of assimilation."

In none of this forester's letters does he answer the specific questions. He did not even suggest how many years we must wait until they begin to fail in assisting the process of assimilation.

Excerpts from letter of C. R. Tillotson, Esq., Acting Chief Eastern Division Forestry Extension, Washington, D. C.

"In order to insure most rapid volume of growth, foresters like to see trees about one half their length clear, and the other half with a crown."

"This is particularly true in the young rapidly growing state of the tree."

"This does not, I know, answer your question, and personally I am unable to answer it."

"So far as I know there has been no specific studies undertaken in this country, with the idea of learning just the extent to which pruning can be practiced without endangering the health or checking the growth of the forest tree." "A few years ago, I saw a young stand of walnut trees which the owner had pruned up rather consistently, and it most assuredly made a fine stand."

Excerpts of letter from Professor F. B. Knapp, Erie Forest School, Duxbury, Mass., April 20, 1922.

"I am absolutely convinced that you are on the right track, on intensive tree growing. You are carrying it much farther than I did."

"I believe annual pruning is as good or better if enough years are omitted, to gradually increase the number of living whorls, until final height is obtained."

"I am absolutely convinced that pruning live branches is no more (harmful) for a forest than an apple tree."

"I am confident that the health and height growth are not injured."

"If you can get foresters to investigate your ideas, something of great value can be accomplished."

"I feel as you do about the established laws of tree growth."

"Too many are without sufficient data and are liable to be reversed."

"In general, people will not even listen or investigate, if the result is outside of the established laws."

"If you would only get them to criticize and back up with something tangible, you would be making real progress."

"Artificial pruning was a paying proposition a dozen years ago. How much more so now?"

"White pine with your method would do well for three years, when they would become suppressed, making little height growth. Twenty cottonwoods a year would give so little light at first that pines would only slightly respond, when all of the cottonwoods are gone, pines would then be thrifty, tall, slender trees, with increasing top and ready to start a good growth, considering them as forming a second and slower rotation, it would give a big start after the cottonwoods are nearly harvested."

Professor Knapp is quite right that under our system the White Pines after a few years will become suppressed, but they would be well established when their liberation begins.

And it is also true that removal of 20 cottonwoods in a year would bring but little relief, but it would be gradual and increasing, while the first year's crop would also include the accumulated defects, and the 20 would be so selected to do the most good or the least harm.

From O. M. Pratt, Esq., North Holderness, N. H., May 7, 1922.

"My experiments in pruning have been wholly with White Pine, and in natural stands only, no planting has been done."

"My prunings have been done with the object in view to obtain a saw log of a better quality than would result if nature were allowed its usual course."

"I pruned 16 feet high and close for that purpose but in young growth do not exceed half the height of the tree at one time."

"The result of my experience led me to believe that pruning to that extent causes no shock to the tree, if the fact of shade is not changed."

"That the removal of limbs, live or dead, does not cause any material difference in the height growth. But it retards the diameter growth in proportion to the number of live leaves or needles removed."

"The effect of shade is, I think, overestimated by the foresters. Trees that are very severely injured, sometimes seem to make better growth than an uninjured one does."

"I am afraid that your theory will be very unpopular with the foresters. Why, I do not know?"

"If they would learn a little more in the woods as I have they might be more practical."

Mr. Pratt's system of one half of the height of the tree at one time, would most likely "change the shade" while if the same pruning, a little at a time, covers several years, the "shade should not be changed," but his practice has not been with artificial planting.

From letter of R. B. Miller, State Forester of Ills.

"My impression has been that you would get the least injury to the tree by keeping your stand so dark as to shade the lower limbs by natural pruning, and I believe this is the opinion of most foresters." "White Pine planted 5 x 5 should prune itself in 15 to 20 years." "Nature is cheap, let her do it."

That is the text book theory, and is accepted as the established law of tree growth by the foresters generally. That is, they are standing where they were a hundred years ago, when time did not count as now. Can we afford to wait fifty years before clear growth begins when we can get more in ten; no other kind will pay the farmer.

"I have seen some very nice plantations of the C. B. & Q. R. R. Co., when the lower limbs of Catalpa had a clear length of 17 feet." "He had taller trees than any one else on the road."

From letter of Professor N. E. Beghtel, Botanist, University of Cincinnati.

"With regard to your hypothetical planting. I am inclined to believe that your schedule for cottonwoods is too severe, a cottonwood pruned in this way will grow in height very rapidly, possibly in excess of what you allow. There will not be a corresponding measure of thickness to support the crown. For example, a tree at 5 years, 23 feet high, pruned 16 feet would probably be much less than 5″ at the stump, it certainly would not stand if left alone."

"The pines will no doubt do quite well in the shade of the cottonwoods. The only question is whether there will be sufficient shade for the White pines during the first years."

This critic's point is well taken about the increased top growth, at the expense of the lower stem, but the danger is more theoretical than practical. My object in pruning the lower limbs so persistently is to accomplish exactly what the professor fears will happen. I have dwelt in the woods too long to be alarmed on that score.

The finest specimen of saw logs, or those having more clear stem, are those of the least taper.

My inquiries on the foregoing questions were mailed to many of the great universities of this country which manifested much interest in the subject, but generally referred my letters to foresters requesting them to give the information sought, most of whom ignored it entirely, some doubted its feasibility, others volunteered advice entirely foreign to the subject, others said that they had no experience in forest tree pruning.

But not one ventured to go on record with an opinion that might be construed as not in conformity with the theories of the guild, except those who have shut their eyes to the consequences of having views of their own, not based entirely on theories of an antiquated past.

They are submitted here to show the state of mind of those who have had opportunities to know, and of the wide divergence of theories yet unproven.

But to the farmer to whom I look for practical aid in this work, it is of no more importance for him to know how trees grow than how corn grows, but it is to him and his fellow man important that he knows how to grow them successfully and profitably.

The first problem is for the scientist, and the field is broad indeed.

The farmer has long since been fully informed as to the forester's system of a thick stand for self-pruning, without being in the least interested in it as an enterprise offering any promise of profit in connection with his farm operations.

But he is interested in any system that may profitably utilize his idle woodlot. It is to that point our efforts have been directed, and I hope our departure from the easy-going, well-beaten paths will blaze the way to a better one.

THE END

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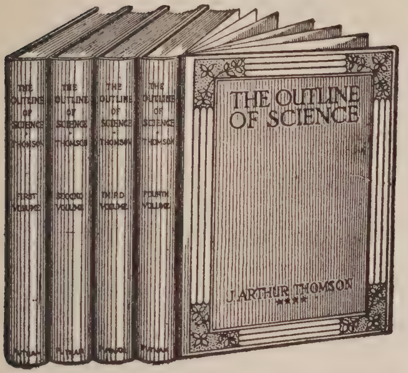

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